DIESEL ENGINE

C190GB, C190KE, C190, C240 MODELS

WORKSHOP MANUAL

ISUZU MOTORS LIMITED

The following manuals in English language version are available for use in inspection, adjustments and repaire of Isuzu light-duty truck and bus series.

MANUALS AVAILABLE / UNIT OR EQUIPMENT APPLICABLE		WORKSHOP MANUALS	SERVICE MANUALS
ENGINE	: G161	G161-WE-741	
	: C190, C240	1924-WE-101	
	: 4BA1, 4BC1	4BAC-WE-001	
	: 4BD1	46BD-WE-011	
CLUTCH		LCLU-WE-001	
PROPELLER SHAFT		LPRO-WE-001	
TRANSMISSION		LTRM-WE-001	
REAR AXLE		LRAX-WE-001	
FRONT AXLE		LFAX-WE-001	
BRAKE		LBRK-WE-001	
STEERING		LSTR-WE-001	
SUSPENSION		LSUS-WE-001	
CHASSIS ELECTRICALS		LCEL-WE-001	
ENGINE ELECTRICALS		HLEE-WE-001	
INJECTION PUMP		—	INJ-SE-011

When design change is effected on some equipment for 1981 year model, the details of changes are outlined in the workshop manuals and those manuals are issued with the new publication number (○○○○-WE-011).

ISUZU

WORKSHOP MANUAL

DIESEL ENGINE

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FOREWORD

This manual includes special notes, important points, service data, precautions, etc. that are needed for the maintenance, adjustments, service, removal and installation of the components of the model titled.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication.

The right is reserved to make changes at any time without notice.

Arrangement of the material is shown by the table of contents on the right-hand side of this page. Black spot on the first page of each section can be seen on the edge of the book below section title. A more detailed table of contents precedes each section.

This manual applies to the 1981 year and later models.

SECTION INDEX

SECTION	NAME
1	GENERAL INFORMATION
2	ENGINE ASSEMBLY
3	LUBRICATING SYSTEM
4	COOLING SYSTEM
5	FUEL SYSTEM
6	INTAKE AND EXHAUST SYSTEM
7	AUXILIARIES
8	SPECIAL TOOL LIST
9	CONVERSION TABLE

SECTION 1
GENERAL INFORMATION

INDEX

CONTENTS PAGE

General repair instructions 1– 1
How to use this manual 1– 2
Application chart 1– 5
Main data and specification 1– 6
Torque specifications 1– 7
Engine repair kit 1–11
Servicing 1–13
Engine oil viscosity chart 1–30
Recommended lubricants 1–31

GENERAL REPAIR INSTRUCTIONS

1. For assurance of safety, park the vehicle on level ground and brace the front or rear wheels when lifting the vehicle.
2. Raise the vehicle with a jack set against the axle or frame and perform service operation after supporting the vehicle on chassis stands.
3. Before performing service operation, disconnect grounding cable from the battery to reduce the chance of cable damage and burning due to short-circuiting.
4. Use a cover on body, seats and floor to protect them against damage and contamination.
5. Brake fluid and anti-freeze solution must be handled with reasonable care as they can cause paint damage.
6. The use of proper tools and special tools where specified, is important to efficient and reliable service operation.
7. Use genuine Isuzu parts.
8. Used cotter pins, gaskets, O-rings, oil seals, lock washers and self lock nuts should be discarded and new ones should be prepared for installation as normal function of the parts can not be maintained if these parts are reused.
9. To facilitate proper and smooth reassembly operation, keep disassembled parts neatly in groups.
   Keeping fixing bolts and nuts separate is very important as they vary in hardness and design depending on position of installation.

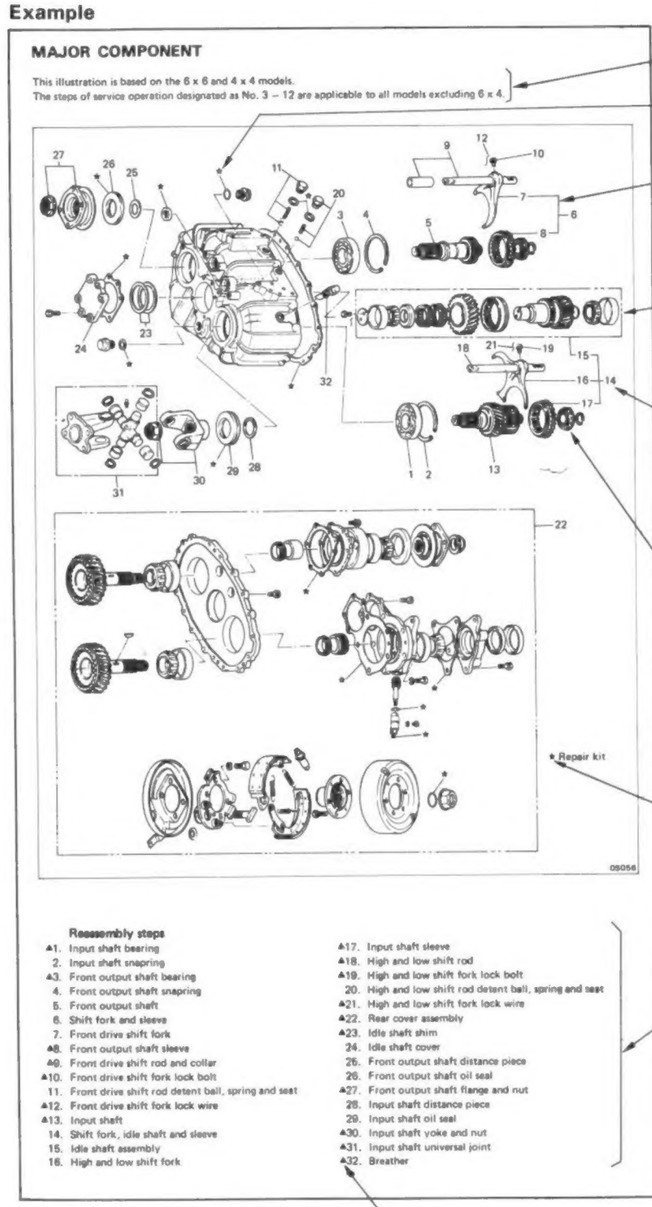
10. Clean the parts before inspection or reassembly. Also clean oil ports, etc. using compressed air to make certain they are free from restrictions.
11. Lubricate rotating and sliding faces of the parts with oil or grease before installation.
12. When necessary, use a sealer on gaskets to prevent leakage.
13. Carefully observe all specifications for bolt and nut torques.
14. When service operation is completed, make a final check to be sure service has been done properly.
15. For assurance of safety, always release air pressure solely from the air tanks before disconnecting pipes, hoses or other parts from any unit under air pressure.

HOW TO USE THIS MANUAL

1. Find the applicable section by referring to the index.
2. This manual includes "General information" section in which service data, maintenance items and specifications with torques are included.
3. Each section includes removal and installation, disassembly, inspection and repair and reassembly. When the same service operation applies to more than one units or equipments, notice is inserted stating, "Refer to manual for other units or equipments".
4. In removal and installation section, description of self-explanatory items such as removal of individual parts from unit to be removed, is omitted and important operation such as adjustments, torque specifications, etc. are dealt with mainly.

5. Each service operation section begins with disassembled view of unit or equipment which is useful to find components, service procedure, availability and content of repair kits, etc.

Example



"Note" indicating models applicable.

★ parts contained in repair kit.

Parts to be removed or installed as a unit.

All units or parts within frame are to be considered as "major component". Each unit or part within frame is to be considered as "minor component".

The number represents sequence of service operation.

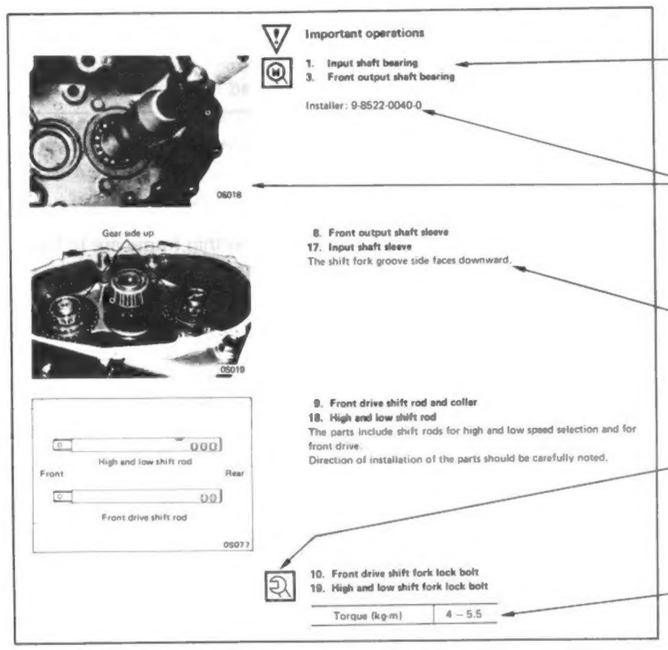
Removal of the parts without number (excluding bolts, nuts, washers, gaskets, cotter pins, etc.) is unnecessary unless when replacement is needed.
Where parts replacement requires specific note, instructions are given in "Inspection and repair".

★ indicates repair kit availability.

Name of parts listed in sequence of service operation.

▲ indicates important operation.
Details of service operation are described in the paragraph "Important operations"

6. The section following illustration(s) deals with important service steps marked with "▲".
This section also includes "notes", "use of special tools", "service data", etc.



Item shown in the illustration and marked with "▲"

Special tools are identified with tool name and/or part number.
The drawing illustrates how the tool is used.

Important note.

The symbol indicates the step of service to be followed.
Refer to the following paragraph for meaning of each symbol.

Service data and specifications are listed in table.

7. In this manual, the following symbols are used to indicate the type of service operations to be performed.

....	Remove	....	Adjustment
....	Install	....	Clean
....	Disassemble	....	Pay close attention — important
....	Reassemble	....	Tighten to specified torque
....	Align the marks	....	Use special tool(s) (Isuzu's tool(s))
....	Correct direction	....	Use special tool(s) (parts manufacturer's tool(s))
....	Inspect	....	Lubricate with oil
....	Take measurement	....	Lubricate with grease

8. The service standard is indicated in terms of "Standard" and "Limit".
The "standard" means the assembly standard and standard range within which the parts are considered serviceable.
"Limit" indicates the limit value (Correction or replacement is necessary when measurement is beyond this limit.)

9. In this manual, the components and parts are printed in singular form.

APPLICATION CHART

C190GB, C190KE ..... Engine with VE type injection pump and belt type timing drive train
C190, C240 ..... Engine with in-line type injection pump and gear type timing drive train

○ Applicable model

Vehicle models \ Engine models		C190GB	C190KE	C190	C240
Passenger car	PAD	○			
Light-duty trucks	*KBD		○		
	KBD			○	
	KAD			○	
	TLD				○

Model with * mark ..... For special territories.

MAIN DATA AND SPECIFICATIONS

Items \ Engine model		C190GB C190KE	C190	C240
Engine type		Water-cooled, 4-cycle in-line, overhead valve type		
Combustion chamber type		Swirl chamber type		
Cylinder liner type		Dry type, Cromard liner		
Timing gear system		Belt drive	Gear drive	
No. of piston ring		Compression ring 2, oil ring 1		
No. of cylinder - bore x stroke	(mm)	4 - 86 x 84		4 - 86 x 102
Total piston displacement	(cc)	1,951		2,369
Compression ratio		20 : 1		
Engine dimensions : length x width x height	(mm)	Approx. GB730x570x625 KE696x666x715	Approx. 682 x 600 x 633	Approx. 685 x 606 x 685
Engine weight (dry)	(kg)	Approx. 220	Approx. 221	Approx. 223
Fuel injection order		1-3-4-2		
Fuel injection timing (B.T.D.C. static)		15°	18°	14°
Type of fuel used		High-speed diesel fuel (SAE No. 2)		
Fuel filter type		Cartridge type		
Injection pump type		Bosch distributor VE type	Bosch in-line A type with automatic timer	
Governor type		Mechanical variable speed (half all speed)	Pneumatic and mechanical variable speed	
Injection nozzle type		Throttle type		
Fuel injection pressure	(kg/cm^2)	105	120	
Compression pressure	(kg/cm^2)	31 (at 200 rpm)		
Idle speed	(rpm)	GB 600 — 650 KE 675 — 725	675 — 725	
Intake and exhaust valve clearance	(cold) (mm)	0.45		
Intake valve open at		11° (B.T.D.C.)		
Intake valve close at		49° (A.B.D.C.)		
Exhaust valve open at		51° (B.B.D.C.)		
Exhaust valve close at		9° (A.T.D.C.)		
Lubrication method		Pressurized circulation		
Oil pump type		Gear type (4 x 4) Rotor type (4 x 2)		Rotor type
Oil filter type		Paper element, full-flow type		
		Cartridge type		Cartridge type or paper element type
Piston cooling		With oiling jets		
Lubricating oil capacity	(liters)	GB 6.0, KE 6.5	6.5	
Oil cooler type		Water-cooled		
Cooling method		Pressurized circulation		
Cooling water capacity	(liters)	9.0		
Water pump type		Impeller type		
Thermostat type		Wax pellet type (with jiggle valve)		
Air cleaner type		Cyclone type combined with paper element type		
Battery type	— Voltage (V) x No. of unit	NS70/NX120-7 — 12 x 1		N100 — 12 x 1
Generator	Voltage — capacity (V—A)	12 — 50/65/80	12 — 40	
Starter	Voltage — output (V—KW)	12 — 1.8/2.2	12 — 1.8	12 — 2.2

TORQUE SPECIFICATIONS

STANDARD BOLTS

The torque values given in the following table should be applied where a particular torque is not specified.

(kg-m)

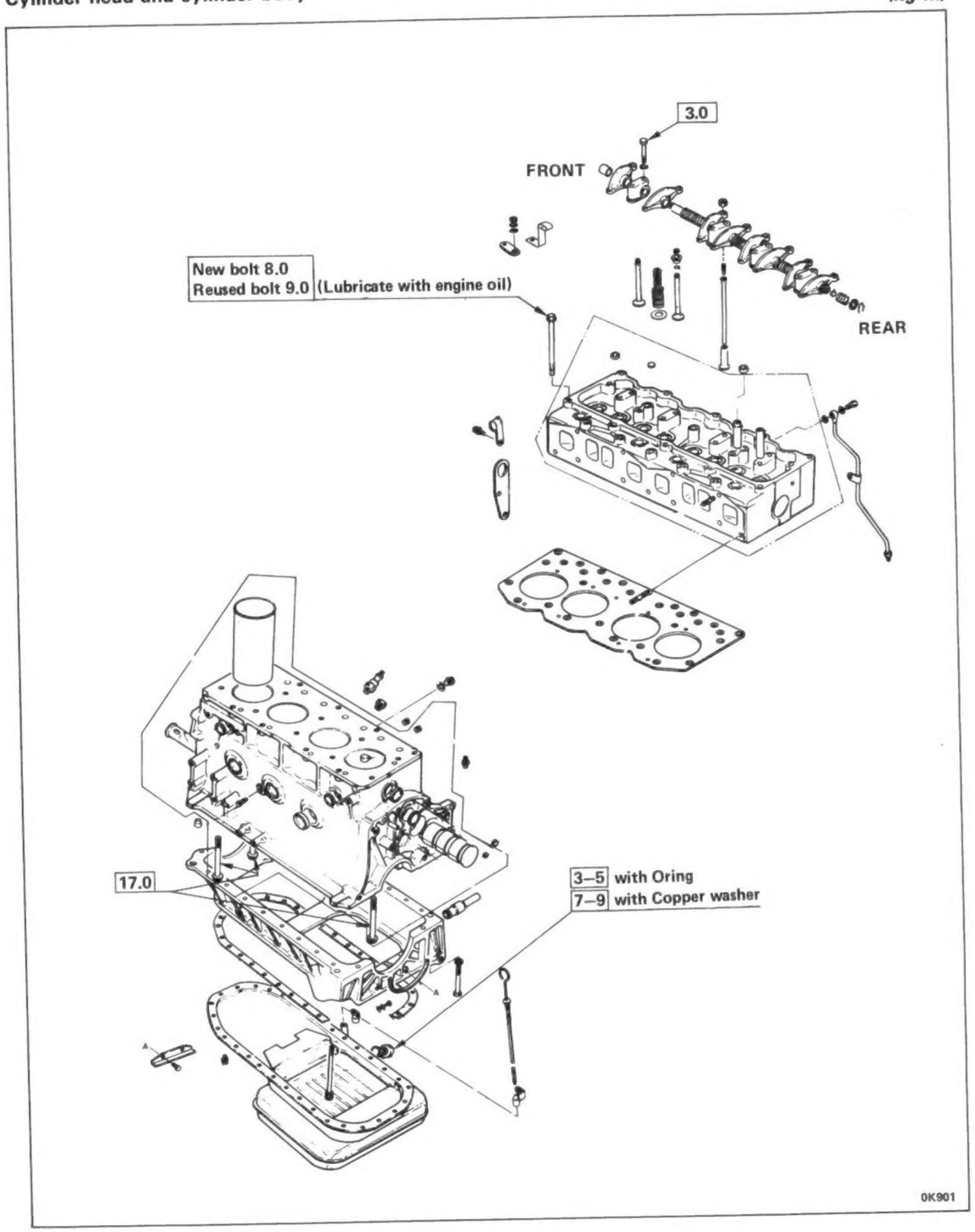
Bolt identification / Bolt diameter x pitch (mm)	4	7	9
	4 T (Low carbon steel)	7 T (High carbon steel)	9 T (Alloy steel)
6 x 1.0	0.4 — 0.8	0.5 — 1.0	—
8 x 1.25	0.8 — 1.8	1.2 — 2.3	1.7 — 3.1
10 x 1.25	2.1 — 3.5	2.8 — 4.7	3.8 — 6.4
*10 x 1.5	2.0 — 3.4	2.8 — 4.6	3.7 — 6.1
12 x 1.25	5.0 — 7.5	6.2 — 9.3	7.7 — 11.6
*12 x 1.75	4.6 — 7.0	5.8 — 8.6	7.3 — 10.9
14 x 1.5	7.8 — 11.7	9.5 — 14.2	11.6 — 17.4
*14 x 2.0	7.3 — 10.9	9.0 — 13.4	10.9 — 16.3
16 x 1.5	10.6 — 16.0	13.8 — 20.8	16.3 — 24.5
*16 x 2.0	10.2 — 15.2	13.2 — 19.8	15.6 — 23.4
18 x 1.5	15.4 — 23.0	19.9 — 29.9	23.4 — 35.2
20 x 1.5	21.0 — 31.6	27.5 — 41.3	32.3 — 48.5
22 x 1.5	25.6 — 42.2	37.0 — 55.5	43.3 — 64.9
24 x 2.0	36.6 — 55.0	43.9 — 72.5	56.5 — 84.7

The asterisk * indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

MAJOR PARTS FIXING BOLTS

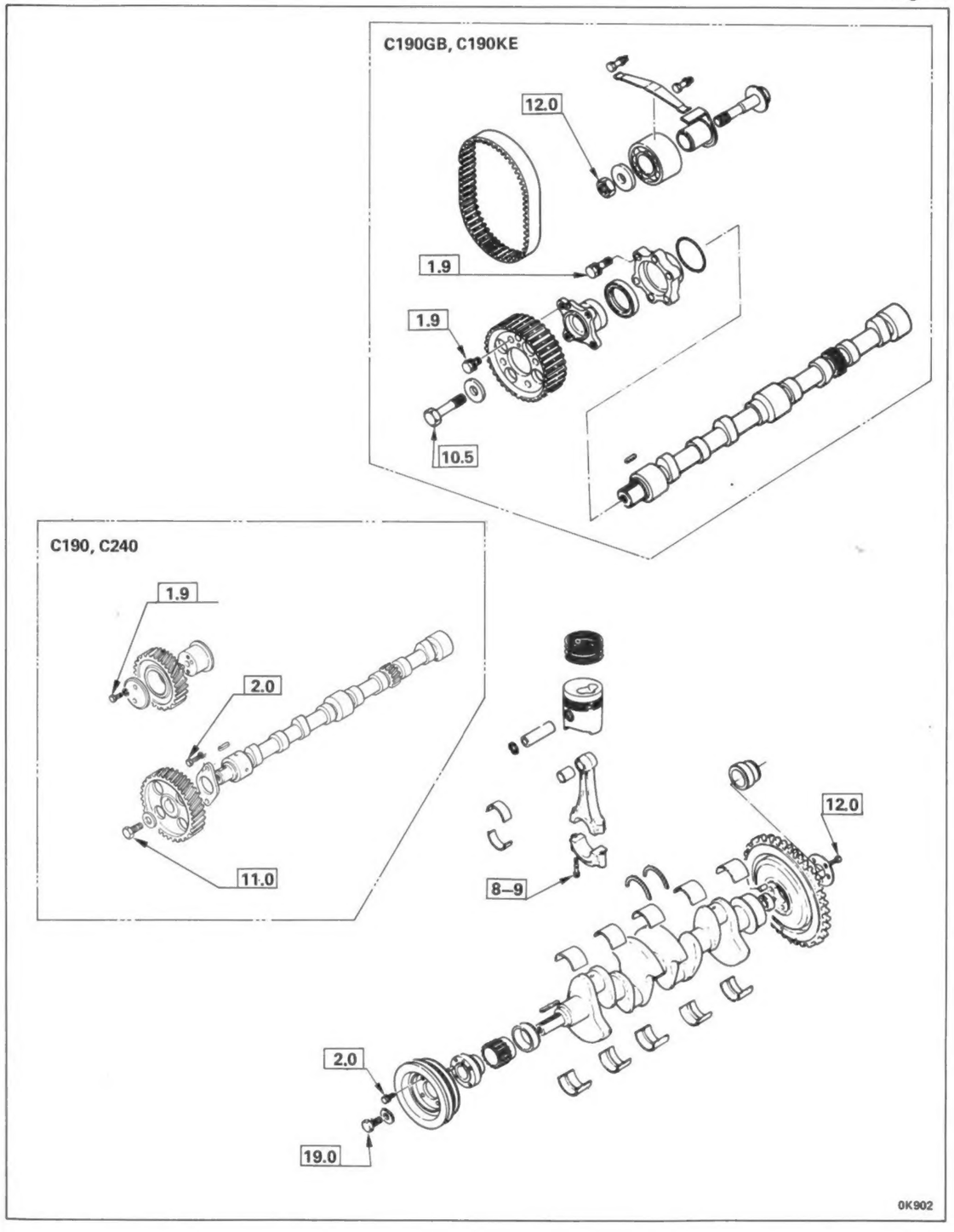
Cylinder head and cylinder body

(kg-m)



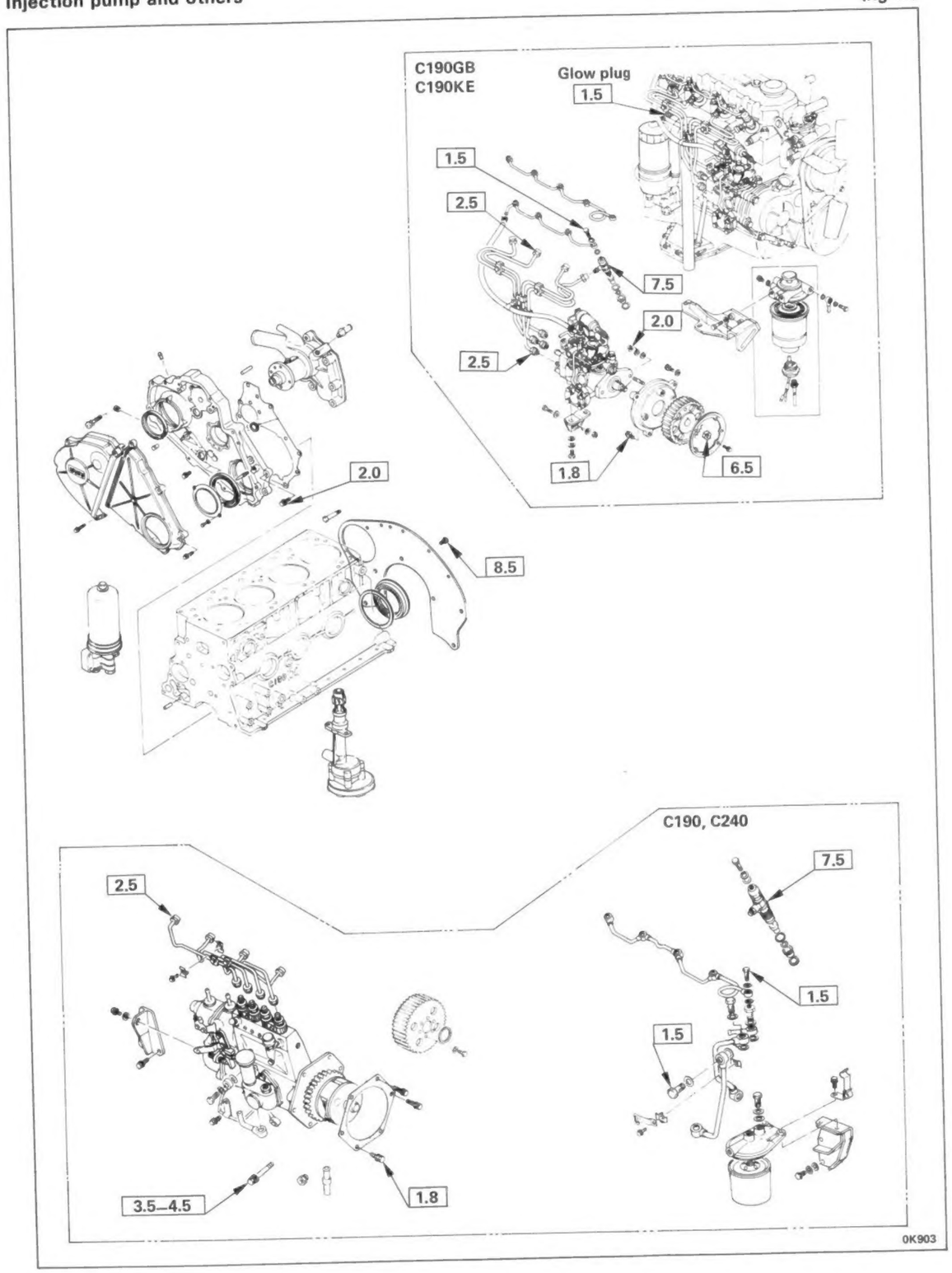
Crankshaft and camshaft

(kg-m)



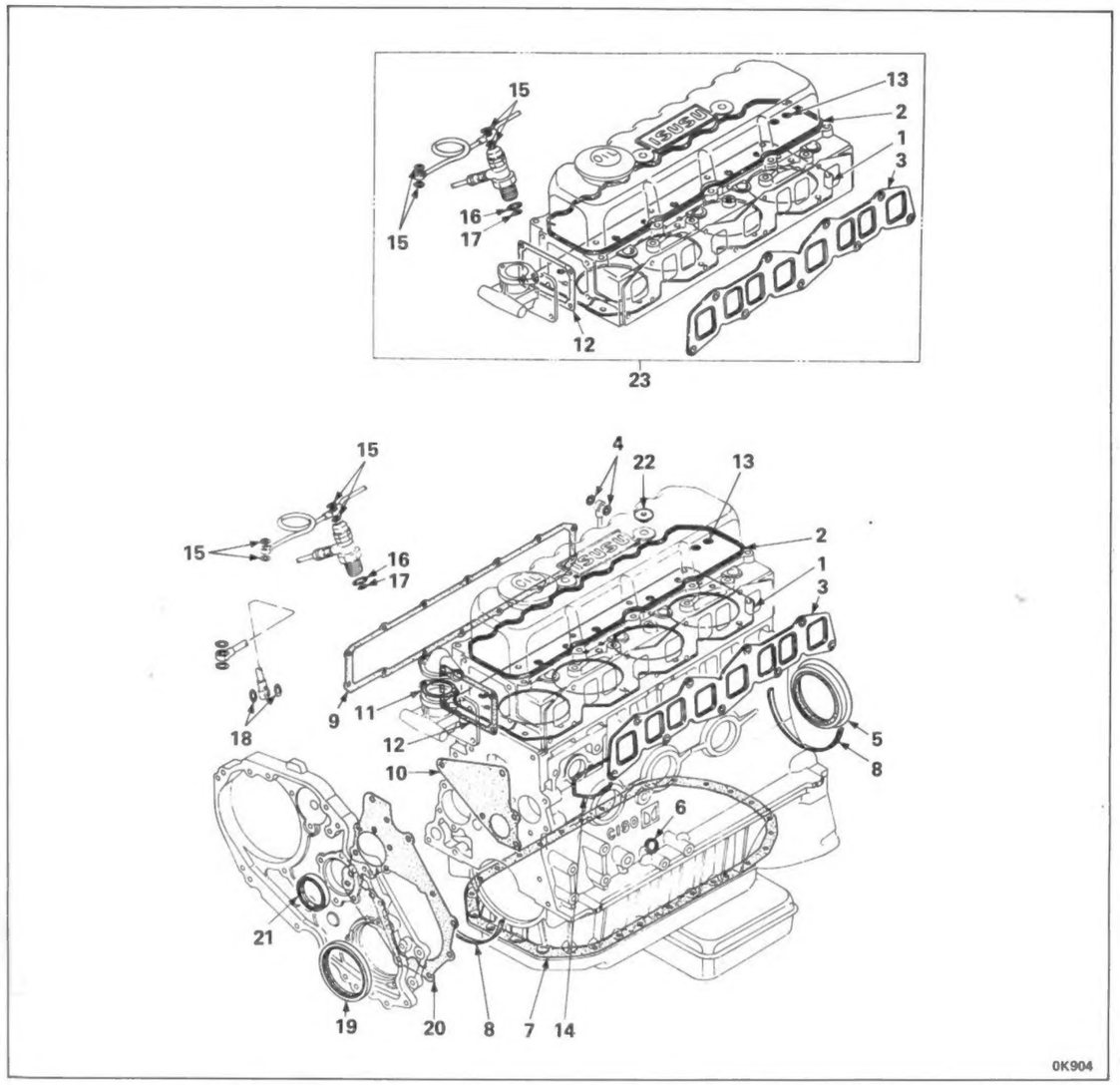
Injection pump and others

(kg-m)



ENGINE REPAIR KIT

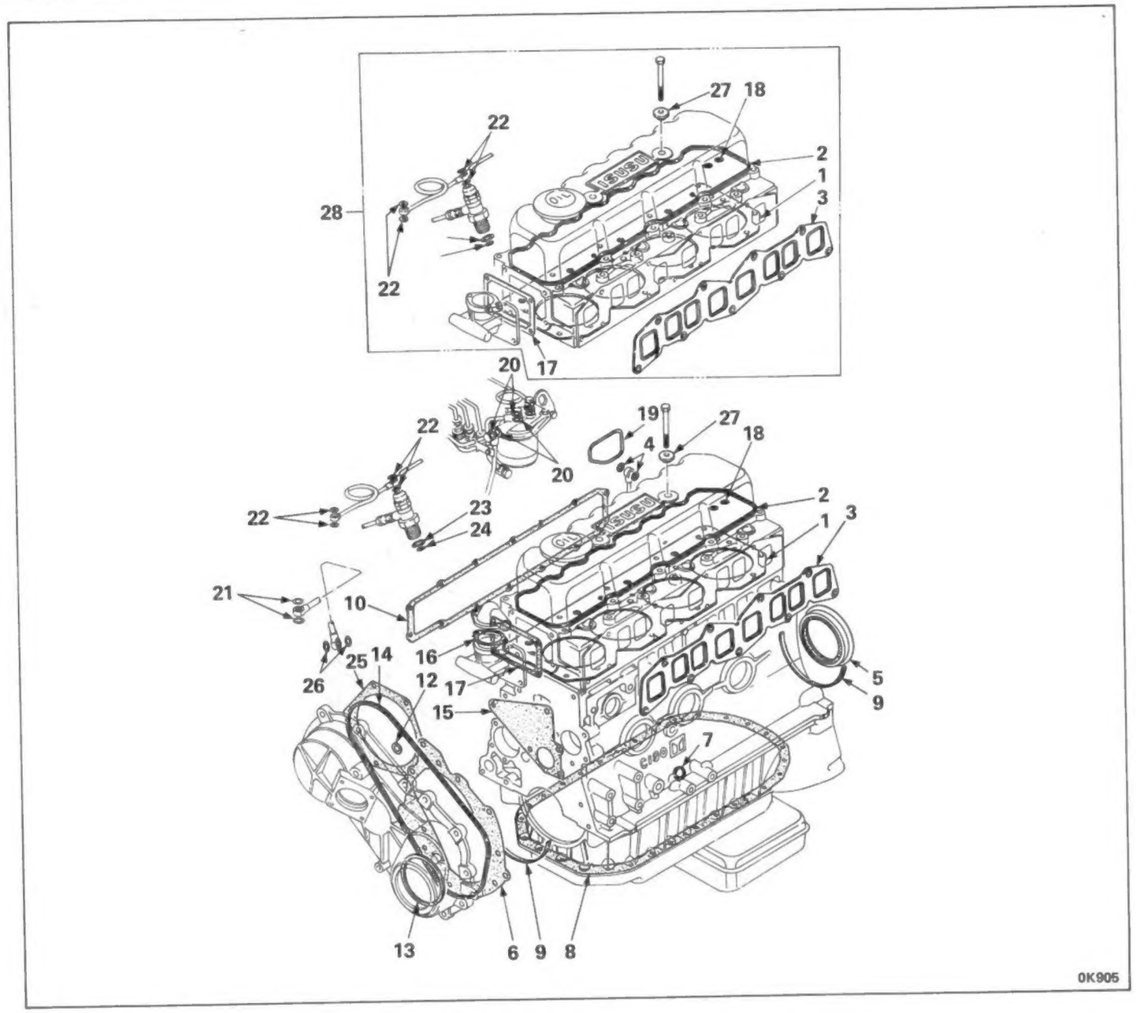
C190GB, C190KE models



1. Gasket : cylinder head
2. Gasket : cylinder head cover
3. Gasket : intake and exhaust manifold
4. Gasket : joint bolt
5. Seal : crankshaft rear
6. Gasket : drain plug
7. Gasket : oil pan to case
8. Gasket : oil pan to bearing cap
9. Gasket : tappet cover
10. Gasket : water pump to cylinder block
11. Gasket : outlet pipe
12. Gasket : cylinder head to housing
13. Sealing ring
14. Gasket : oil filter to block
15. Gasket : throttle valve
16. Gasket : nozzle holder
17. Washer : corrugated, holder
18. Gasket : vacuum pipe
19. Oil seal: crankshaft, front
20. Gasket : body to housing
21. Gasket : pulley to pump
22. Gasket : head cover
23. Repair kit : top over haul

ENGINE REPAIR KIT

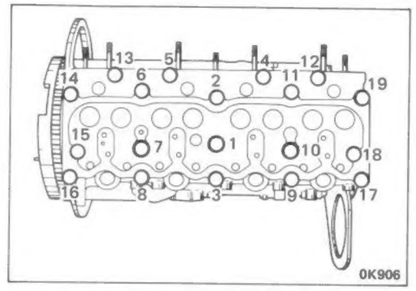
C190; C240 models



1. Gasket : cylinder head
2. Gasket : cylinder head cover
3. Gasket : intake and exhaust manifold
4. Gasket : joint bolt
5. Seal : crank shaft rear
6. Gasket : front plate
7. Gasket : drain plug
8. Gasket : oil pan to case
9. Gasket : oil pan to bearing cap
10. Gasket : tappet cover
12. Gasket : gear case
13. Seal : oil
14. Gasket : gear case
15. Gasket : water pump to cylinder block
16. Gasket : outlet pipe
17. Gasket : cylinder head to housing
18. Ring : sealing
19. Gasket : oil filter to clock
20. Gasket : fuel pump
21. Gasket : vacuum pipe
22. Gasket: throttle valve
23. Washer : nozzle holder
24. Washer : corrugated, holder
25. Gasket : bracket to front plate
26. Gasket : vacuum pipe
27. Gasket : head cover bolt
28. Repair kit : top overhaul kit

SERVICING

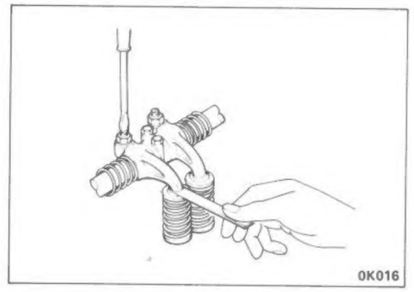
CYLINDER HEAD



Tighten the cylinder head bolts in sequence as shown in the figure.

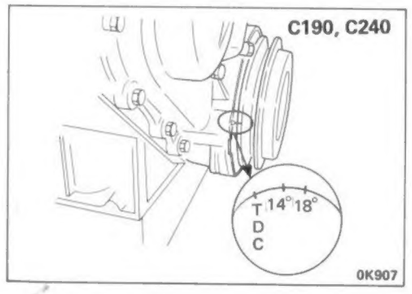
Torque	(kg-m)	8.0

VALVE CLEARANCE

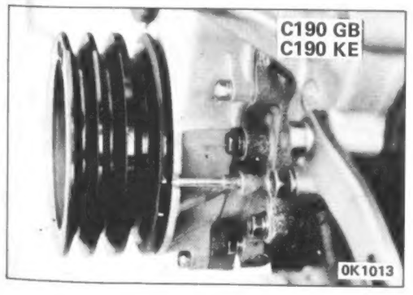


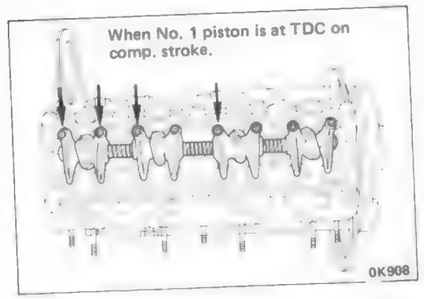
Adjust the valve clearances in the following manner using a feeler gauge.

	(mm)
Intake and Exhaust (in cold)	0.45

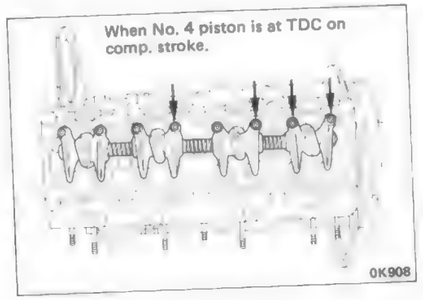


Turn the crankshaft until the TDC notched line on crankshaft pulley is aligned with the pointer to bring the piston in either No. 1 or No. 4 cylinder into top dead center on compression stroke. Hand-feel looseness of intake and exhaust valve push rods on the No. 1 cylinder. When both the push rods have a play, it indicates that the No. 1 piston is at top dead center on compression stroke. When the valves on No. 1 cylinder are pushed open, it indicates that the No. 4 piston is at top dead center on compression stroke.



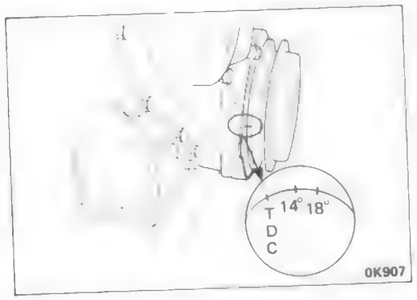


Adjust the clearances of the valves marked with an arrow.



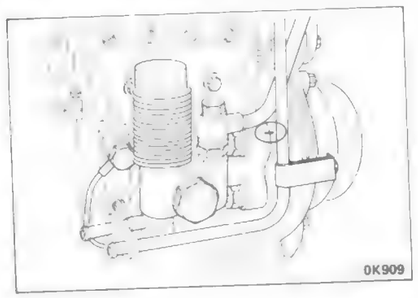
After adjusting the valve clearances referring to the drawing, turn the crankshaft one full turn in the rotative direction and align the TDC mark with the pointer, then adjust the remaining valve clearances.

INJECTION TIMING



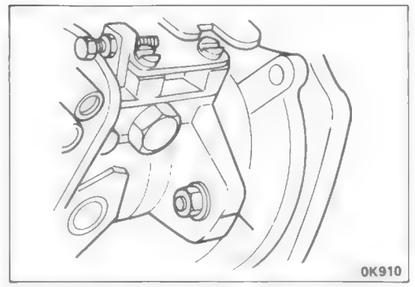
(C190, C240)

Timing	C190	18°
	C240	14°



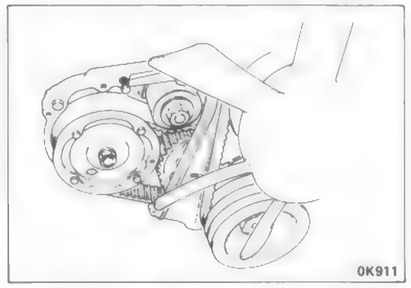
Check that notched line on the injection pump is in alignment with notched line on the injection pump bracket.

AIR CLEANER



(C190GB, C190KE)

Check that notched line on the injection pump flange is in alignment with notched line on the front plate.



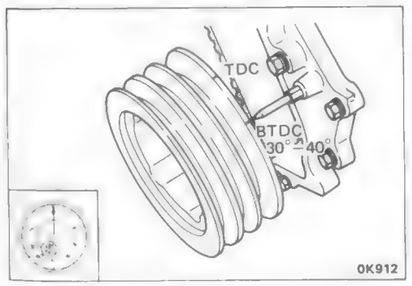
Adjustment

Bring the piston in No. 1 cylinder to top dead center on compression stroke by turning the crankshaft as necessary. With the front upper cover removed, check that timing belt is properly tensioned and that timing marks are aligned.

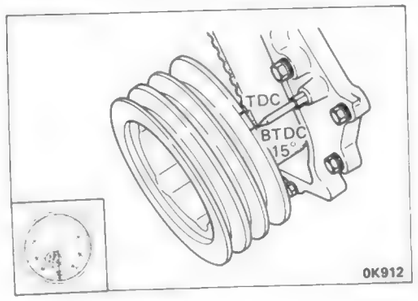
Disconnect the injection pipe from the injection pump and remove the distributor head screw, then install measuring device.

The dial indicator should be installed with the probe depressed inward by approximately 2 mm.

Measuring device



Bring the piston in No. 1 cylinder to a point 30 — 40 degrees before top dead center by turning the crankshaft, then calibrate the dial indicator to zero.



Turn the crankshaft until the line 15° on damper pulley is brought into alignment with the pointer, then take reading of the dial indicator.

(mm)

Standard reading	0.47 — 0.53
Timing	15°

Turn the crankshaft in normal direction of rotation.

If the injection timing deviates from the specified range, loosen pump fixing nuts and bracket bolts, then make an adjustment by varying injection pump setting angle.

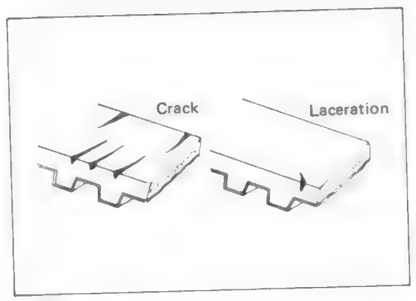
- When larger than standard value;
  Turn the injection pump toward the engine so that the dial gauge indication falls within the standard value.
- When smaller than standard value;
  Turn the injection pump away from the engine so that the dial gauge indication falls within the standard value.

TIMING PULLEY (C190GB)

Timing pulley

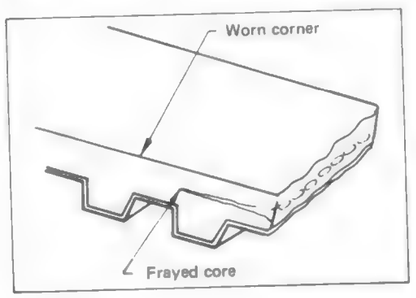
If the timing pulleys are found to be fouled with oil or grease, clean with gasoline or light oil and wipe dry quickly.

Timing belt

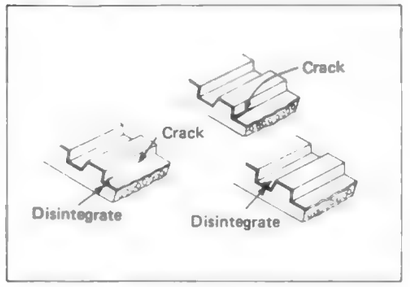


Visual check

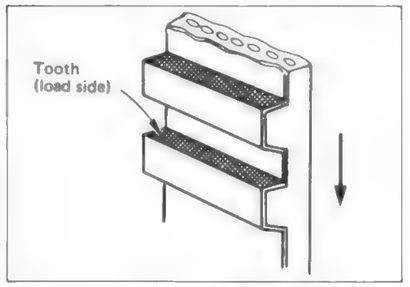
The belt must be replaced if cracks are found in the side and rear faces.



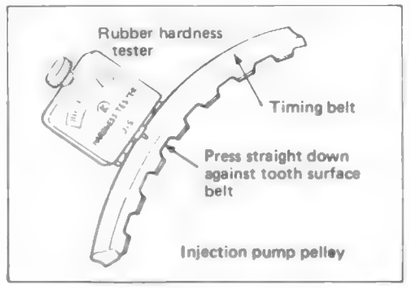
Also replacement is necessary when abnormal wear is found in the side face.



Replacement is necessary when fabric is found to be cracked or disintegrated.



Replacement is also necessary when cogs are found to have abnormal wear.



Take measurements at 3 — 5 points around the circumference of the belt. The belt must be replaced evne if a single measurement if beyond the limit.

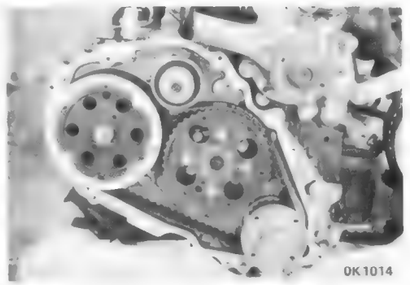
Limit of rubber hardness (HS)	90

Rubber hardness tester

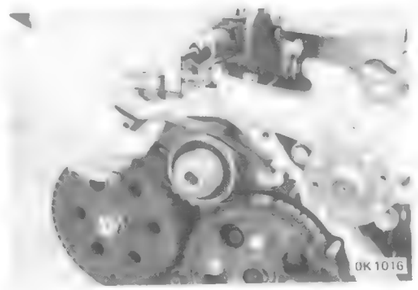
Timing belt replacement (C190GB, C190KE)

Removal

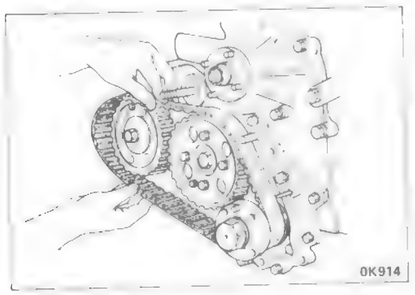
Remove the crankshaft pulley and pulley housing covers A and B, then remove the injection pump timing pulley flange.



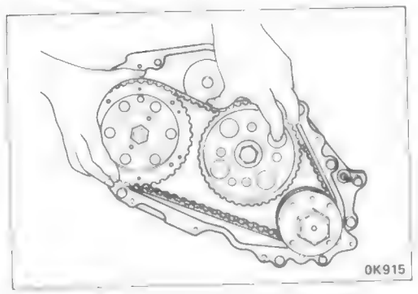
Install the crankshaft pulley and bring the piston in No. 1 cylinder to top dead center on compression stroke. Check to make certain the mark "▲" on the injection pump timing pulley is in alignment with the mark "▲" on the camshaft pulley. Secure the injection pump pulley and camshaft pulley with the bolts.



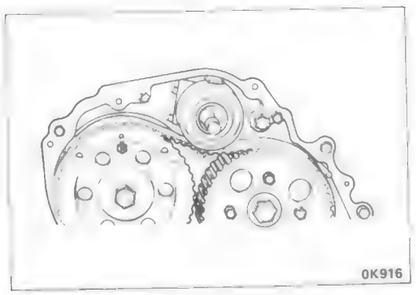
Remove the crankshaft pulley, then remove the tension spring, tension bearing and tension center.



Replace the timing belt.

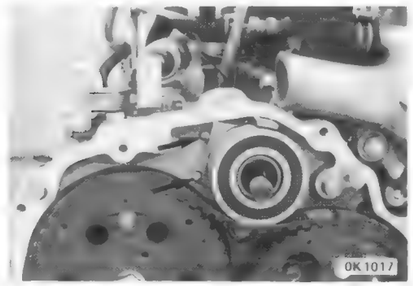


Check to make sure the mark on the timing pulley and on the crankshaft pulley are in alignment with the pointer. Set the belt on the crankshaft pulley, camshaft pulley and injection pulley in that sequence, then adjust to have the slackness of timing belt taken up by the tension pulley.



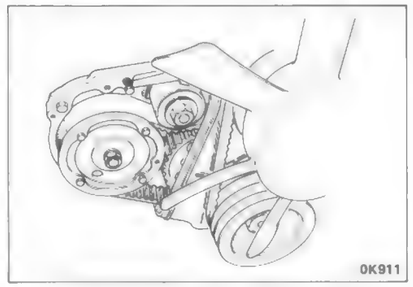
Install the tension center and tension bearing in the following manner: Install the tension center, so that its end is in proper contact with the pins on the front pulley. Install and hand-tighten the tension bearing nut. Install the tension spring and remove the pulley fixing bolts, then semi-tighten the tension bearing nut.

Nut semi-tightening torque (kg-m)	3 — 5



Turn the crankshaft 2 turns in normal direction of rotation. Further turn the crankshaft 90 degrees beyond the top dead center. Loosen the tesion beaing nut to take up slackness of the belt, then tighten the nut to specification.

Torque (kg-m)	11 — 13

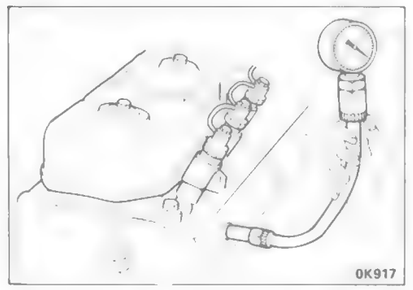


Install the flange by aligning hole in the outer circumference of the flange with the mark "▲" on the injection pump. Turn the crankshaft 2 turns and check that timing marks "▲" on the pulleys are in alignment.

Injection timing

Refer to Section 1 general information on page 1-15 for Injection timing adjustment.

COMPRESSION PRESSURE



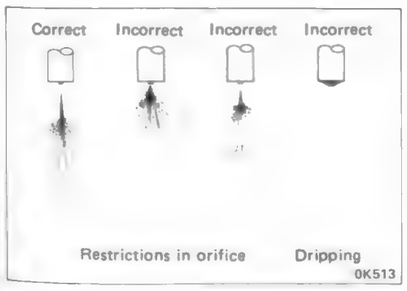
Remove the glow plugs from all cylinders, then check the compression pressure in each cylinder with a compression gauge by engaging starter.

(kg/cm² at 200 rpm)

Standard	Limit
31.0	22.0 — 23.0

Adaptor : 5-83571-002-0

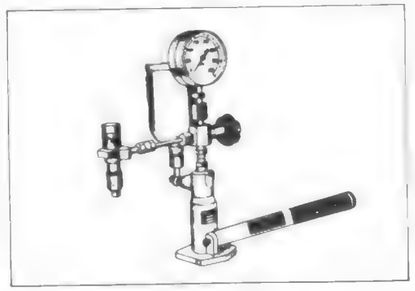
FUEL SYSTEM



Injection nozzle

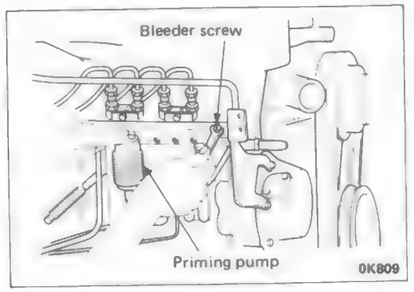
Check the spraying condition and injection starting pressure.

Injection pressure (kg/cm²)	C190GB, C190KE	105
	C190, C240	120



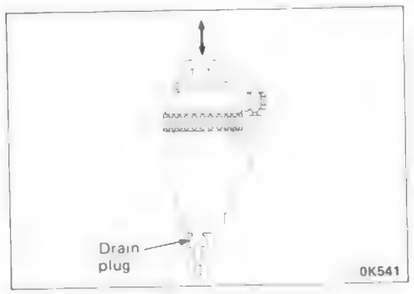
Adjustment

Adjust the injection starting pressure with the adjusting screw using a nozzle tester.



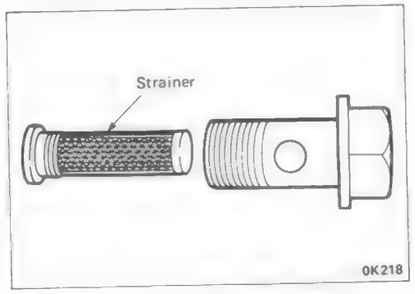
Bleeding (C190, C240)

Bleed the system by manually operating the priming pump with the fuel filter outlet joint bolt and injection pump bleeder screw loosened.



(C190GB, C190KE)

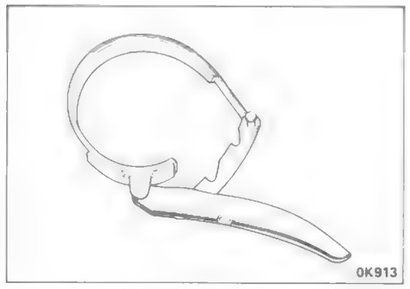
Fill the injection pump chamber with diesel fuel through the overflow valve hole.
Move the hand pump located on the fuel filter up and down.



Feed pump strainer (C190, C240)

Remove the strainer using a screw driver. Wash the strainer in clean diesel fuel.

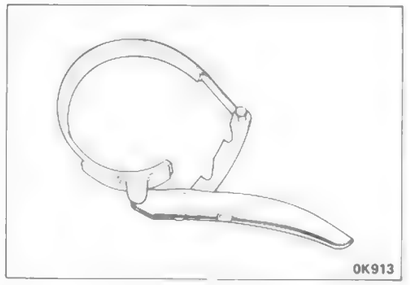
Fuel filter replacement



Remover and installer

Apply diesel fuel to O-ring. Turn in filer until sealing face is brought into contact with the O-ring. Further tighten 2/3 of a turn.

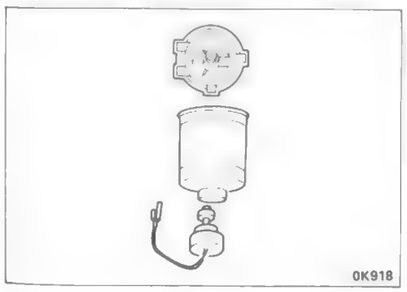
Fuel sedimentor (if equipped)



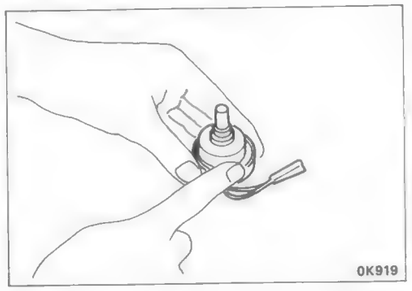
Removal steps:

1. Disconnect water separator sensor wiring at the connector.
2. Remove the filter using filter wrench.

Filter wrench

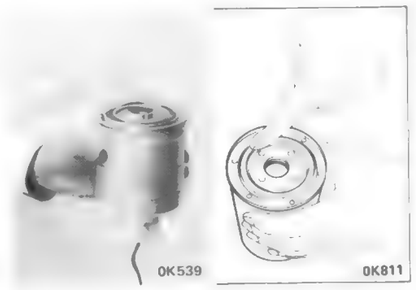


3. Remove the sensor from filter.



Installation steps

1. Install the sensor on a new filter.
   Apply diesel fuel to the O-ring before installation.



2. Fill the filter sufficiently with diesel fuel before installing it in the housing.
   Apply diesel fuel to O-ring. Turn in filter until sealing face is brought into contact with the O-ring. Further tighten 2/3 of a turn.

AIR CLEANER

Viscus type air cleaner. (PAD, KBD)

The viscus type air clearer element should not be cleaned for reuse and should be replaced with a new one.

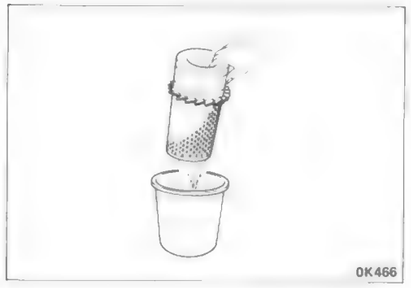
Dry type air cleaner. (KAD, TLD)

Cleaning of element

When the element is fouled with dust
Apply compressed air to the element from inside while turning it with hand. The pressure of compressed air should not exceed 7 kg/cm^2.

Inspection of element

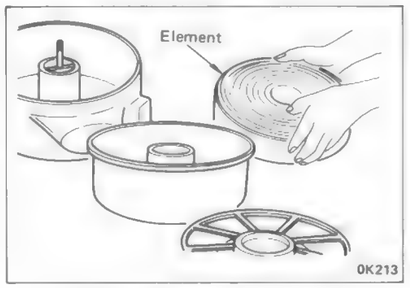
After allowing the element to dry completely, check for the damage using a light bulb within the element.



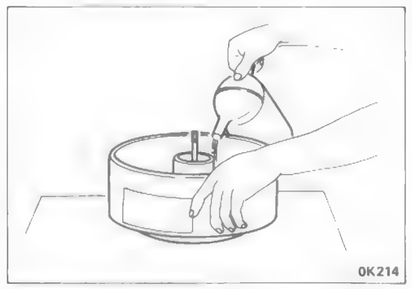
When the element is fouled sooty:

Prepare cleaning solution by diluting essential element cleaner (Donaldson D1400) with water and keep the element submerged in solution for about 20 minutes.
Take out the element and rinse well with running water.
Allow the element to dry in a well ventilated place or using an electric fan. Avoid use of compressed air or open flames for quick drying. It is recommended that a spare element be used as it normally takes 2 — 3 days for natural drying.

Oil bath type air cleaner (Option)



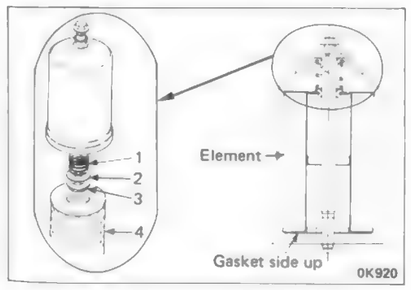
Wash clean the element in detergent oil, Wash the case to remove dust and other foreign matter.



Install the element and case after cleaning. Fill the oil pan to the specified level using engine oil.

Oil capacity	(liter)	0.7

LUBRICATING SYSTEM

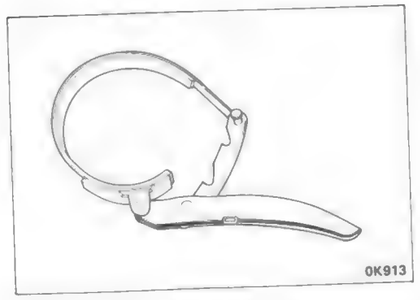


Main oil filter

C240 only

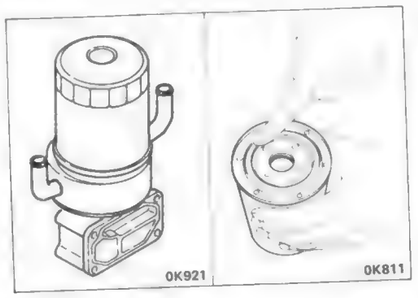
Install the element assembly in sequence of spring (1) spring seat (2) and rubber gasket (3).

With oil cooler type



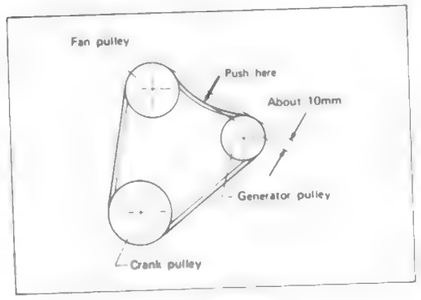
Remover and installer

Filter wrench



Apply engine oil to O-ring. Turn in filer until sealing face is brought into contact with the O-ring. Further tighten 2/3 of a turn.

FAN BELT

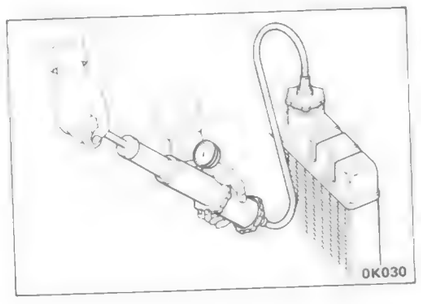


Adjustment

Adjust belt tension by moving generator pulley.

Specified belt deflection (mm)	10

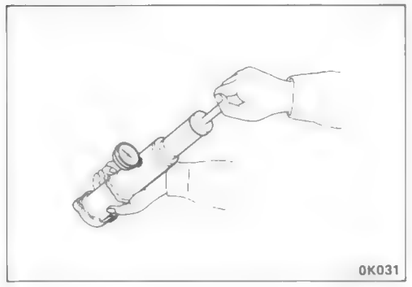
RADIATOR



Install radiator filler cap tester on the radiator and check the cooling system for leakage by applying tersting pressure.
Testing pressure should not exceed the specified pressure.

(kg/cm²)

Testing pressure	2.0

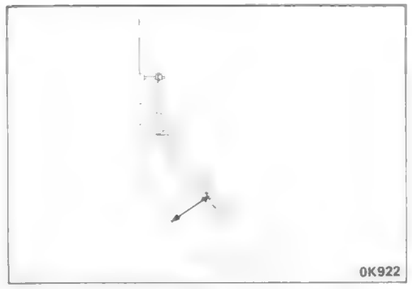


Radiator filler cap

(kg/cm²)

Pressure valve	Negative Pressure valve
0.9 — 1.2	0.04 — 0.05

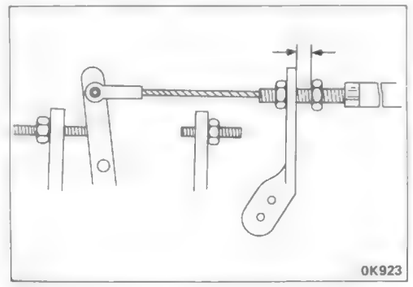
ENGINE CONTROL



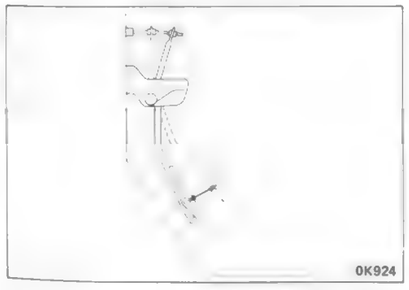
PAD model

Inspection of accelerator pedal height from floor.

Height	(mm)	114

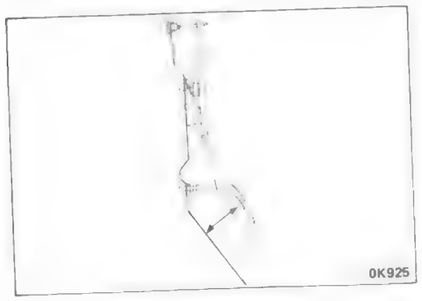


Tighten the nut B until play in the inner cable is completed removed. Adjust the clearance between the bracket and nut to 2 — 3 mm. Tighten the nut B until nut A makes contact with the bracket, then lock the nut B.



When adjustment at pump side is completed, check that accelerator pedal stroke is within the specified value.

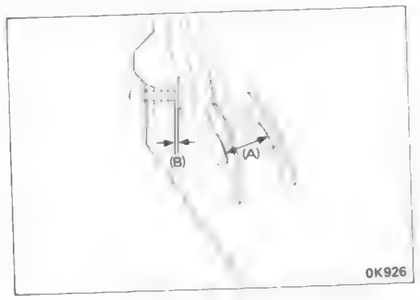
Stroke	(mm)	65



KBD model

Inspection of accelerator pedal height from floor.

Height	(mm)	94

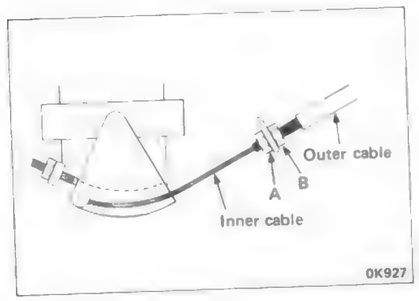


Adjustment of pedal stroke

Stroke (A)	(mm)	40

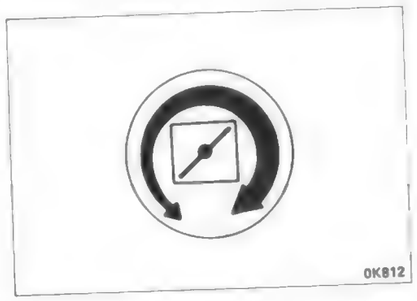
Clearance between pedal and pedal stopper bolt

Clearance (B)	(mm)	0 — 3



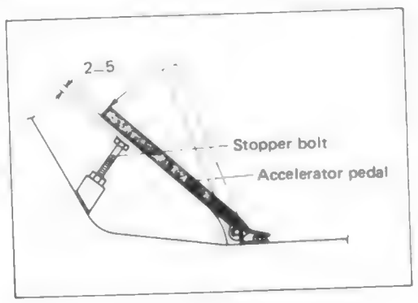
With the throttle valve closed completely, set the outer cable, so that play in the inner cable is removed. Back off the nut A one or two turns and lock the nut in that position with the nut B.

Play of inner cable	(mm)	2 — 3



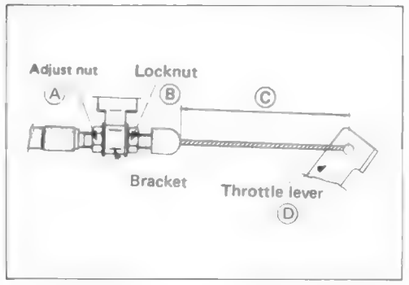
Adjustment of idling

1. Start and let the engine idling until cooling water temperature reaches 70 — 80°C.
2. Returned the idling control knob to idling position.
3. Check that engine idling speed is within the range of from 600 — 650 rpm (PAD) or 675 — 725 rpm (KBD).
   If the idling speed deviates from the specified range, adjust with the throttle valve adjust bolt.



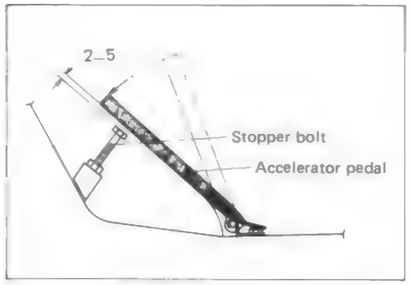
KAD, TLD models

The accelerater is controlled by means of the cable.

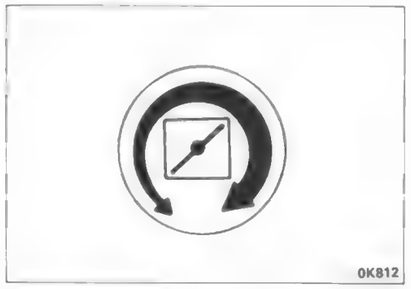


Adjustment

1. Check that idling control knob is returned to home position.
2. Hold the throttle lever Ⓓ in fully closed position and remove slackness of cable Ⓒ with adjust nut Ⓐ.
3. Lock the lock nut Ⓑ.



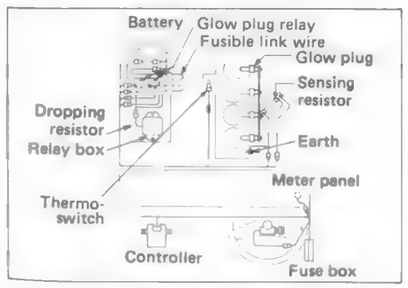
Adjust setting of the stopper bolt, so that the clearance between the end of the stopper bolt and lower face of the accelerater pedal is adjusted to the range (2 — 5 mm) when the throttle valve is fully closed completely.



Adjustment of idling

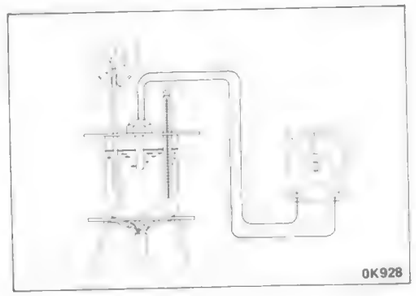
1. Start and let the engine idling until cooling water temperature reaches 70 — 80°C.
2. Returned the idling control knob to idling position.
3. Check that engine idling speed is within the range of from 675 — 725 rpm.
   If the idling speed deviates from the specified range, adjust with the throttle valve adjust bolt.

QUICK ON SYSTEM



Quick on system circuit diagram

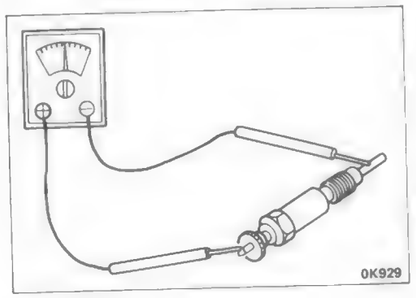
A quick on start device is newly employed to minimize the time for preheating and to ensure easy stating.



Thermo switch

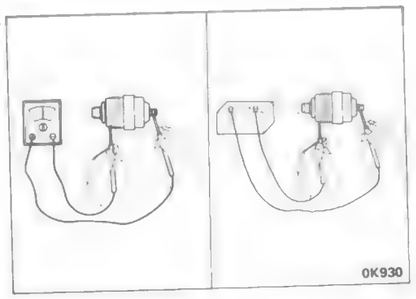
Operating temperature

Switch OFF	47 — 53°C or higher
Switch ON	43 — 50°C or lower



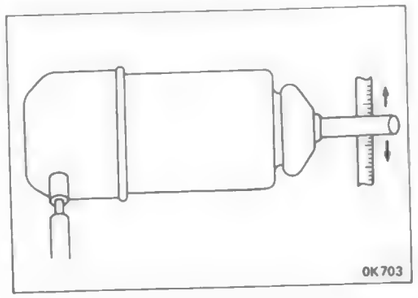
Glow plugs

Check for continutity across the plug terminals and body.



Fuel cut solenoid (VE pump only)

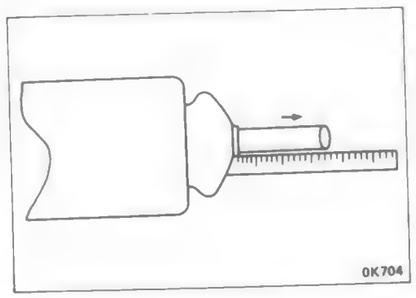
Check for continuity across the plug terminals and solenoid. Operation of solenoid can also be tested using a battery.



Fast idle control device (VE pump only)

Check the shaft for run-out at end of shaft against center of solenoid.

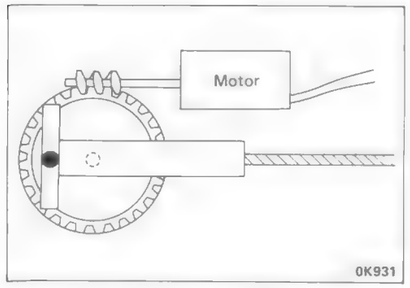
Standard	(mm)	2.5 or less



Measure the plunger stroke as it jumps out.

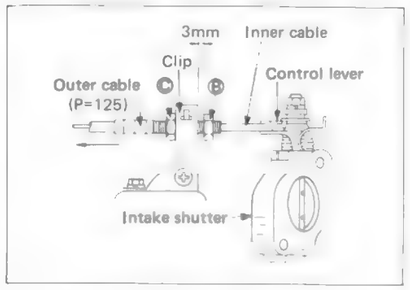
Standard	(mm)	4.5 — 6.0

ELECTRICAL INTAKE SHUTTER (C190, C240



Motor

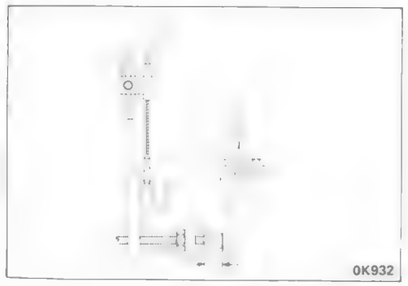
Check to make certain the intake shutter operates properly when the starter switch is turned on.



Adjustment of cable

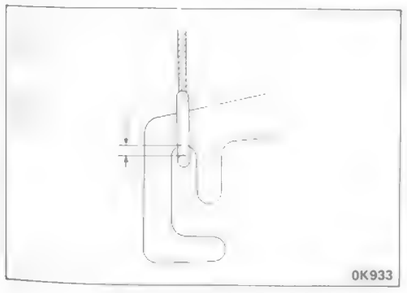
1. With the starter switch off loosen the nuts Ⓐ and Ⓑ . Pull the outer cable in direction of arrow until play in the inner cable is removed completely, then tighten the nut Ⓐ temporarily.
2. Adjust the clearance between the bracket and nut Ⓑ to 3 mm then turn in the nut Ⓐ.
3. Check to make certain the engine stalls when the starter switch is turned off.

FUEL ENRICHMENT DEVICE (OPTION)



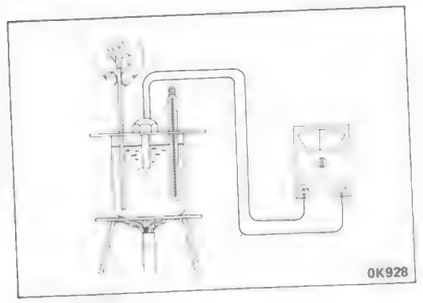
Adjustment of cable

1. Connect the joint at end of cable to the control lever.
2. Install the stopper clip in position between smoke set screw and control lever.
3. Pull the outer cable until play in the inner cable is completely removed.
4. Tighten the clamp bolt when play in the inner cable is



5. Remove the stopper clip.
6. Clearance between control lever and joint.

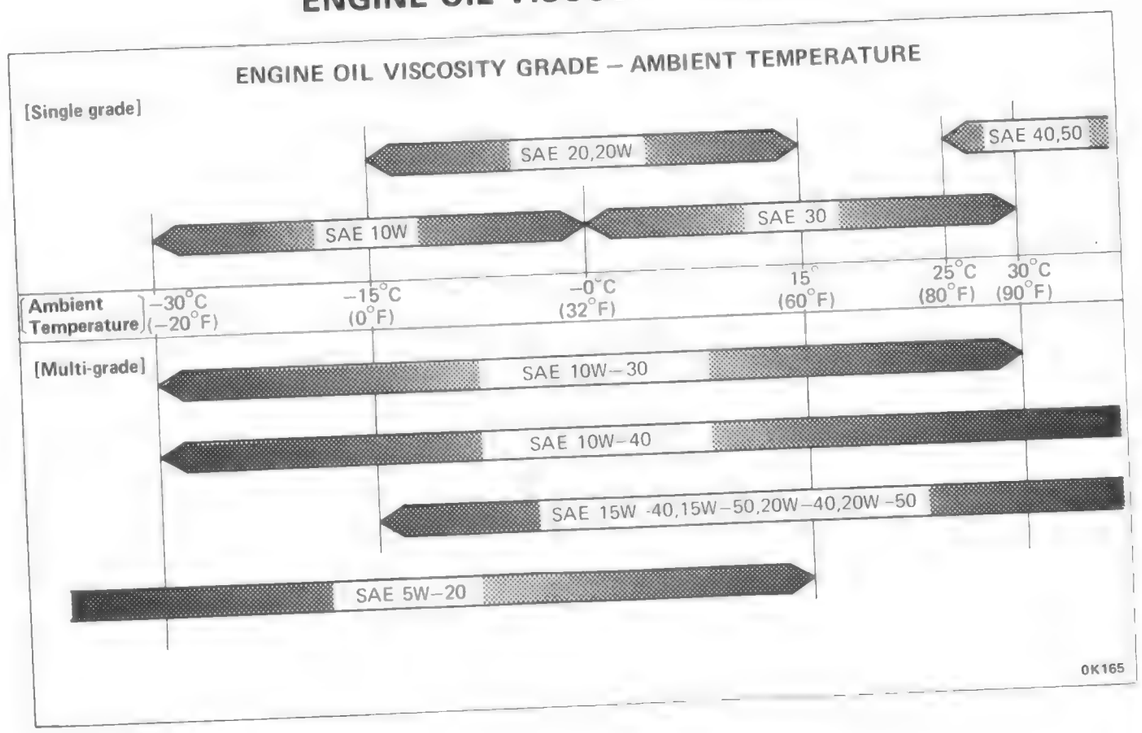
Standard	(mm)	0.5 — 1.5



Thermo switch

The thermo switch is preset to turn on at the coolant temperature of 10°C or below and to turn off when the coolant temperature increases beyond 10°C.

ENGINE OIL VISCOSITY CHART



RECOMMENDED LUBRICANTS

*Mark ... Isuzu genuine lubricants

LUBRICATION	TYPE OF LUBRICANT	MAKE AND BRAND
Engine	Diesel engine oil CC or CD grade	**CC grade** *BESCO SUPER ENGINE OIL BP ENERGOL HD OIL BP VANELLUS M BP SUPER VISCO STATIC BP VISCO 2000 BP VANELLUS M MULTIGRADE CHEVRON DELO 200 MOTOR OIL CHEVRON DELO 100 MOTOR OIL CASTROL or DEUSOL CRB CALTEX FIVE STAR MOTOR OIL CALTEX RPM DELO 200 OIL CALTEX RPM DELO 100 OIL ESSOLUBE HDX ENI AGIP F.1 DIESEL GAMMA ENI AGIP F.1 SUPER MOTORIL ENI AGIP F.1 MOTOR OIL HD MOBIL DELVAC 1100 SERIES MOBIL HEAVY DUTY MOBIL SPECIAL MOBIL DELVAC SPECIAL MOBIL 1 SHELL ROTELLA SX OIL SHELL ROTELLA TX OIL SUNOCO SUNLUBE MOTOR OIL SUNOCO DYNALUBE MOTOR OIL SUNFLEET MIL-B TEXACO HAVOLINE MOTOR OIL TEXACO URSA OIL EXTRA DUTY TEXACO URSATEX TOTAL GTS TOTAL RUBIA H UNION HEAVY DUTY MOTOR OIL **CD grade** *BESCO S-3 ENGINE OIL BP VANELLUS C3 BP VANELLUS C3 MULTIGRADE CHEVRON DELO 400 MOTOR OIL CHEVRON DELO 300 MOTOR OIL CASTROL or DEUSOL CRD CASTROL or DEUSOL CRF CASTROL or DEUSOL RX SUPER CALTEX RPM DELO 400 OIL CALTEX RPM DELO 300 OIL ESSOLUBE D-3 ENI AGIP F.1 DIESEL SIGMA MOBIL DELVAC 1200 SERIES MOBIL DELVAC 1300 SERIES MOBIL DELVAC SUPER MOBIL DELVAC SHC SHELL RIMULA CT OIL SHELL RIMULA X OIL SHELL MYRINA OIL SUNFLEET SUPER C SUNFLEET DIESELUBE SUNFLEET DIESELUBE XD TEXACO URSA OIL SUPER TEXACO URSA OIL LA-3 TOTAL RUBIA S TOTAL RUBIA TM UNION GUARDOL MOTOR OIL

*Mark ... Isuzu genuine lubricants

LUBRICATION	TYPE OF LUBRICANT	MAKE AND BRAND
Injection pump governor	Hydromaster and airmaster paste	BP SHOCK ABSORBER OIL CALTEX CAPELLA OIL 22WF CASTROL ICEMATIC 44 CHEVRON REFRIGERATION OIL 32 ENI AGIP F.1 TER 34 ENI AGIP F.1 SHOCK ABSORBER ESSO ZERICE 15 MOBIL GARGOYLE ARCTIC OIL LIGHT SHELL CLAVUS OIL 17 SUN SUMISO GS OIL SUNFILL M-3310 TEXACO CAPELLA OIL 22WF TOTAL LUNARIA 46
Engine cooling system	Permanent type anti-freeze solution	*ISUZU ANTI-FREEZE PT BP ANTIFROST CALTEX AF COOLANT CASTROL ANTI-FREEZE CHEVRON ATLAS PERMA-GUARD ANTI-FREEZE AND COOLANT ENI AGIP F.1 ANTI-FREEZE ESSO RAD MOBIL PERMAZONE SHELLZONE SHELL GLYCOSHELL PLUS SHELLSAFE TEXACO ANTI-FREEZE COOLANT TEXACO STARTEX ANTI-FREEZE COOLANT TOTAL ANTIGEL UNION YEAR AROUND ANTI-FREEZE AND COOLANT

SECTION 2

ENGINE ASSEMBLY

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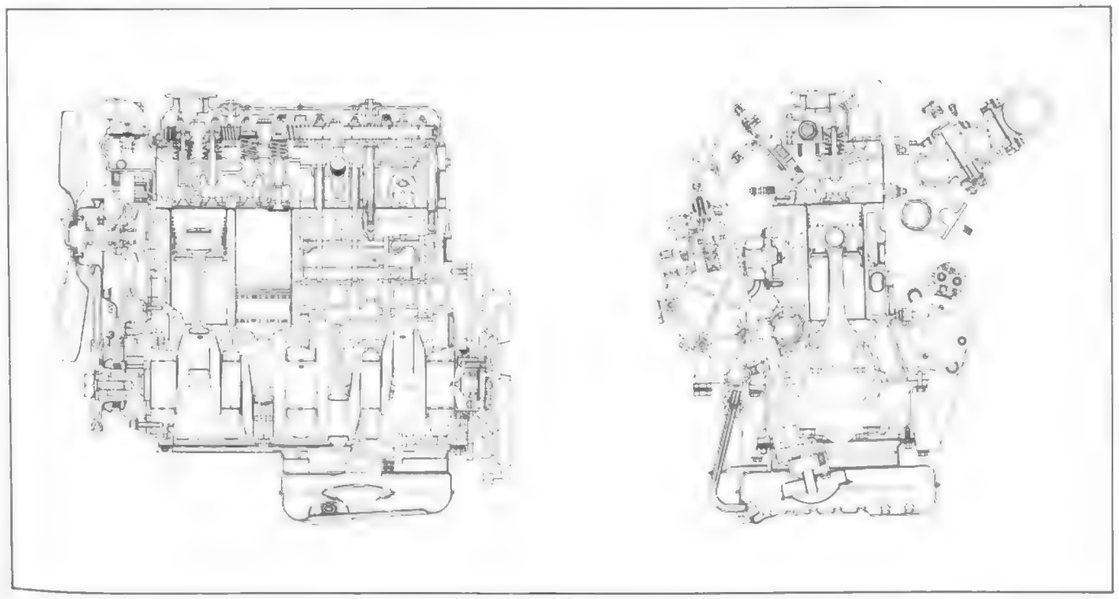
General description ..... 2— 1
Removal and installation ..... 2— 3
Disassembly ..... 2—10
Inspection and repair ..... 2—22
Reassembly ..... 2—41

GENERAL DESCRIPTION

C190 C240 models



*Mark ... Isuzu genuine lubricants

LUBRICATION	TYPE OF LUBRICANT	MAKE AND BRAND
Injection pump governor	Hydromaster and airmaster paste	BP SHOCK ABSORBER OIL CALTEX CAPELLA OIL 22WF CASTROL ICEMATIC 44 CHEVRON REFRIGERATION OIL 32 ENI AGIP F.1 TER 34 ENI AGIP F.1 SHOCK ABSORBER ESSO ZERICE 15 MOBIL GARGOYLE ARCTIC OIL LIGHT SHELL CLAVUS OIL 17 SUN SUMISO GS OIL SUNFILL M-3310 TEXACO CAPELLA OIL 22WF TOTAL LUNARIA 46
Engine cooling system	Permanent type anti-freeze solution	*ISUZU ANTI-FREEZE PT BP ANTIFROST CALTEX AF COOLANT CASTROL ANTI-FREEZE CHEVRON ATLAS PERMA-GUARD ANTI-FREEZE AND COOLANT ENI AGIP F.1 ANTI-FREEZE ESSO RAD MOBIL PERMAZONE SHELLZONE SHELL GLYCOSHELL PLUS SHELLSAFE TEXACO ANTI-FREEZE COOLANT TEXACO STARTEX ANTI-FREEZE COOLANT TOTAL ANTIGEL UNION YEAR AROUND ANTI-FREEZE AND COOLANT

SECTION 2

ENGINE ASSEMBLY

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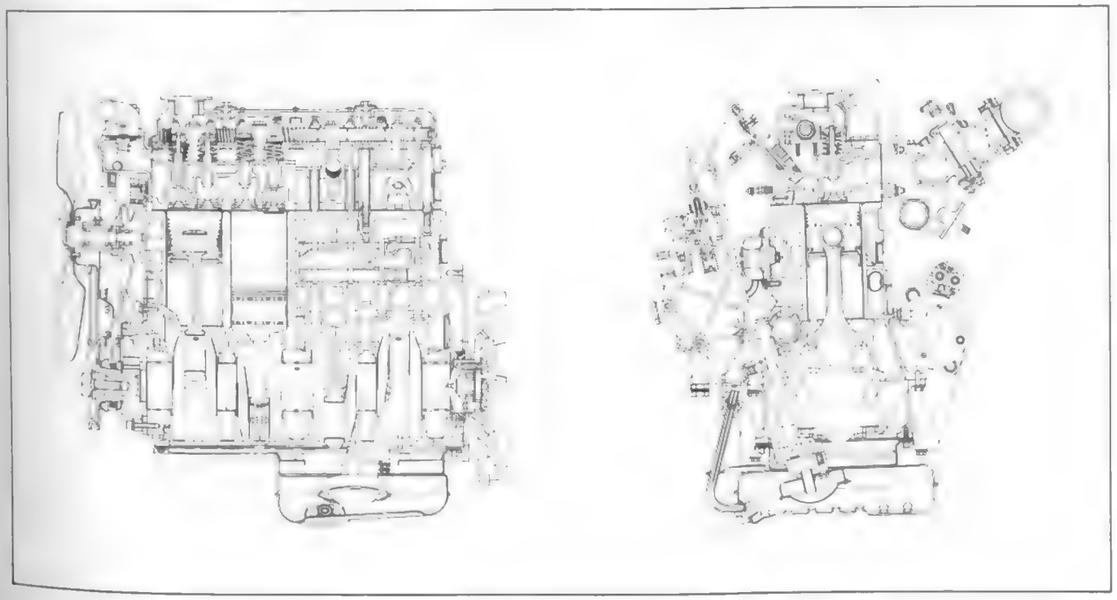
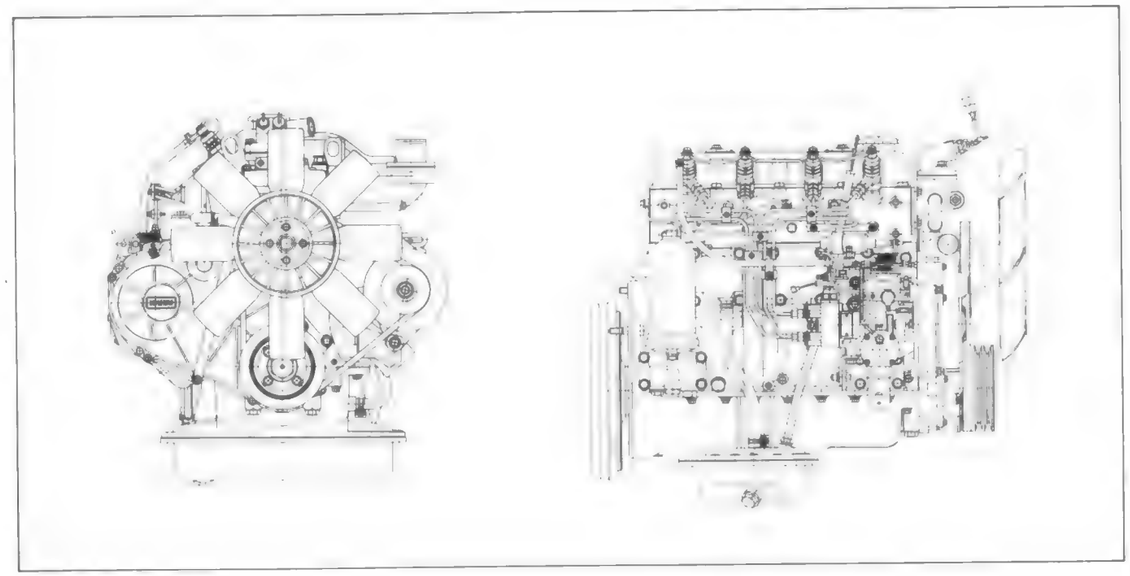
GENERAL DESCRIPTION

C190 C240 models



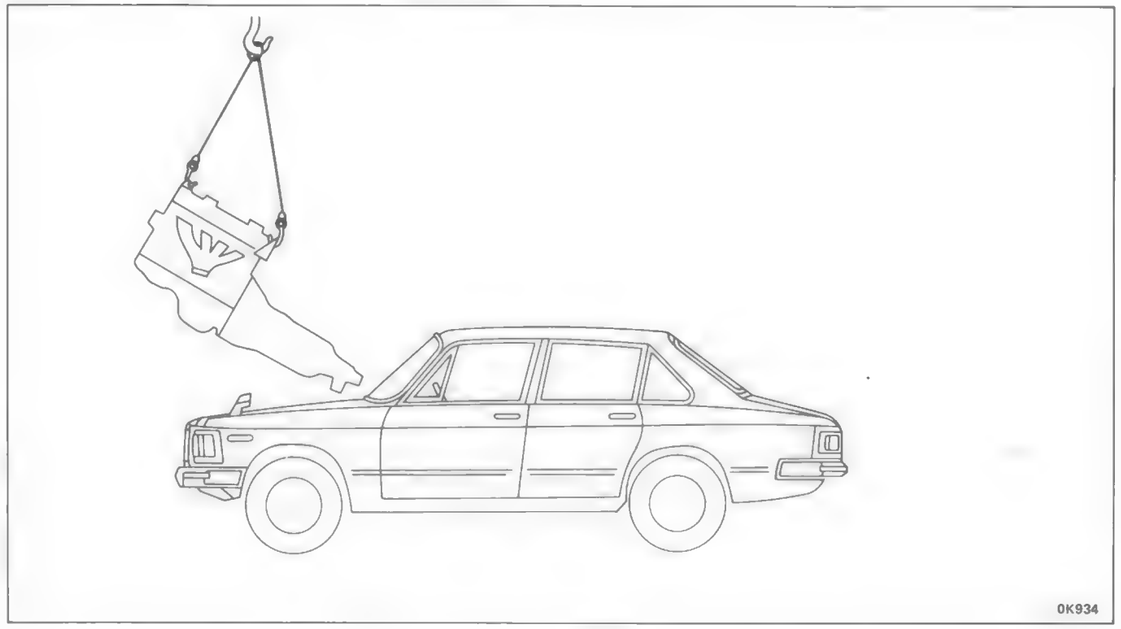
C190GB model



REMOVAL AND INSTALLATION

This section deals only with major service operations and major component parts removal and installation.

PASSENGER CAR



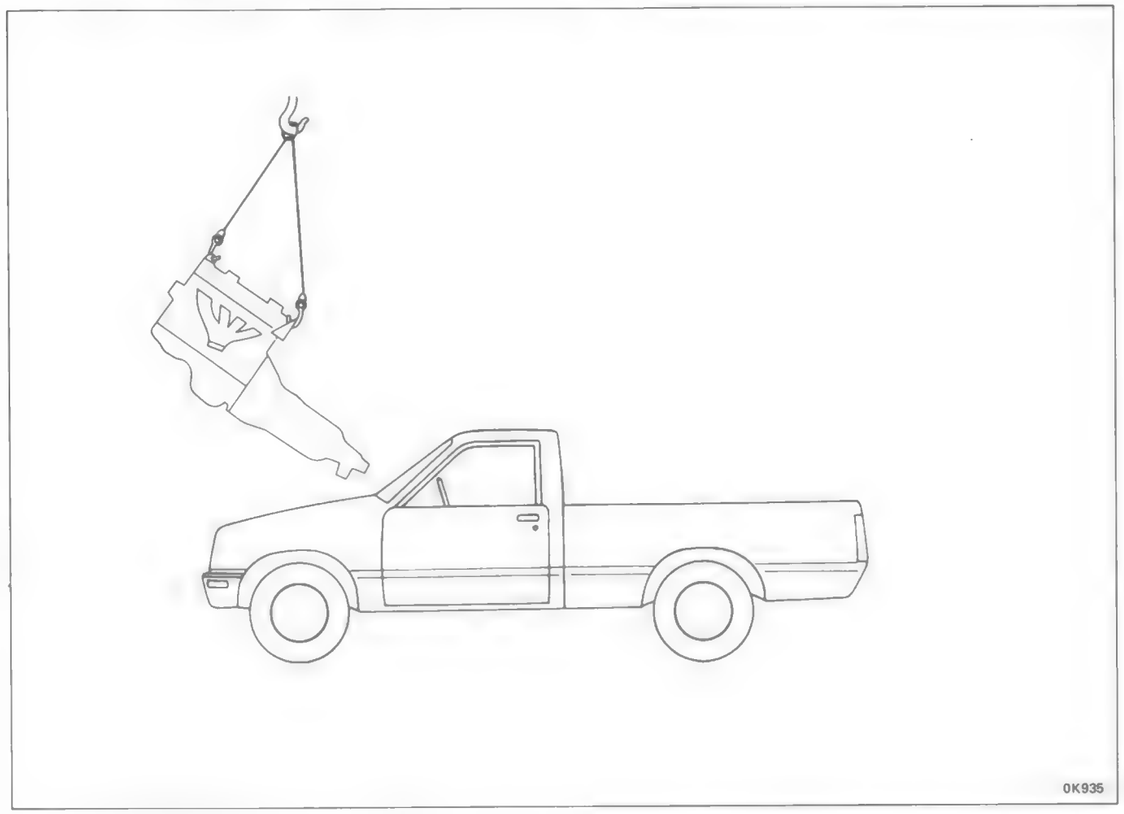
Removal steps

1. Battery cable
2. Engine hood
3. Fan and fan shroud
4. Exhaust pipe
5. Gearshift lever
6. Clutch cable
7. Propeller shaft
8. Engine

Installation steps

To install, follow the removal procedure in reverse order.

LIGHT-DUTY-TRUCK (KBD 4 x 2 model)



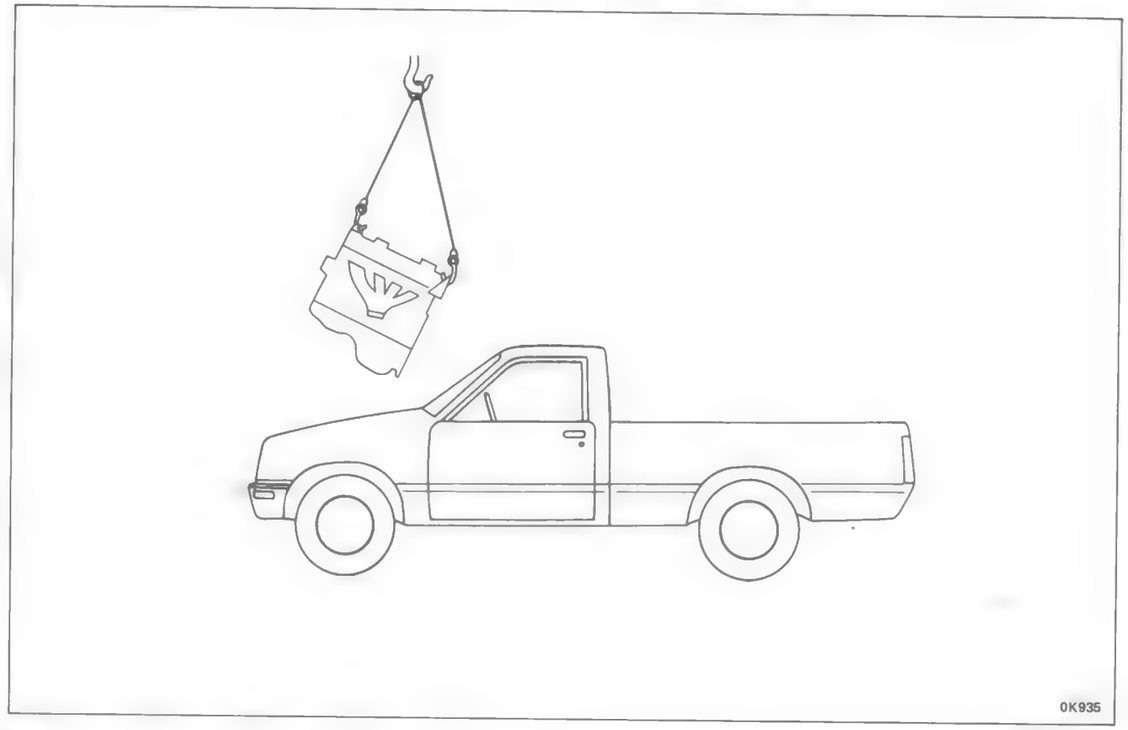
Removal steps

1. Battery
2. Engine hood
3. Fan and fan shroud
4. Exhaust pipe
5. Gearshift lever
6. Clutch cable
7. Propeller-shaft
8. Engine with transmission

Installation steps

To install, follow the removal procedure in reverse order.

LIGHT DUTY-TRUCK (KBD 4 x 4 model)



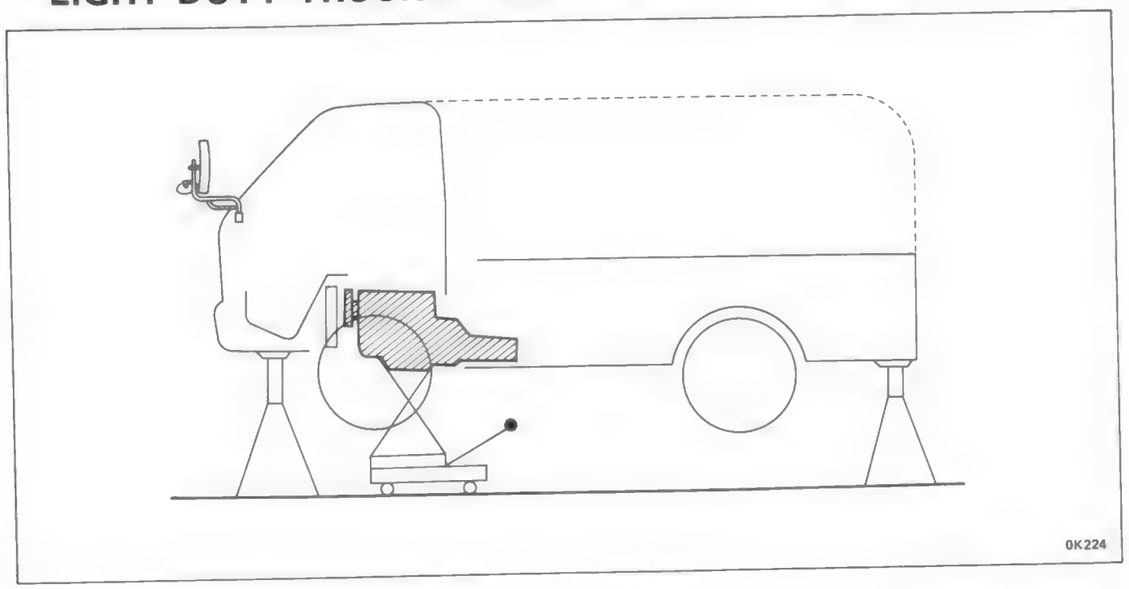
Removal steps

1. Battery cable
2. Engine hood
3. Fan and fan shroud
4. Exhaust pipe
5. Gearshift lever
6. Qudardrand box
7. Clutch cable
8. Propeller shaft
9. Starter motor
10. Transmission rear mounting and bracket
11. Transfer side case
12. Transmission
13. Engine

Installation steps

To install, follow the removal procedure in reverse order.

LIGHT-DUTY-TRUCK AND BUS (KAD and TLD models)



Removal steps

- ▲ 1. Battery cable and electrical cable
- ▲ 2. Engine cover
- ▲ 3. Radiator hose and heater hose
- 4. Intake pipe vacuum hose and fuel pipe
- 5. Engine control cable
- 6. Exhaust pipe
- 7. Tie rod
- 8. Transmission control rod
- 9. Clutch slave cylinder
- 10. Speedometer cable
- 11. Parking brake cable
- 12. Propeller shaft
- 13. Exhaust pipe bracket
- ▲ 14. Engine foot bracket
- 15. Transmission mount bracket
- ▲ 16. Engine with transmission
- 17. Engine

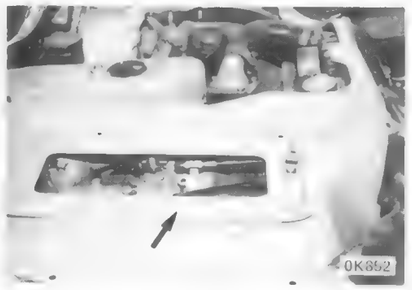
Installation steps

- 1. Engine
- ▲ 2. Engine with transmission
- ▲ 3. Transmission mount bracket
- ▲ 4. Engine foot bracket
- ▲ 5. Exhaust pipe bracket
- ▲ 6. Propeller shaft
- 7. Parking brake cable
- 8. Speedometer cable
- 9. Clutch slave cylinder
- 10. Transmission control rod
- ▲ 11. Tie rod
- ▲ 12. Exhaust pipe
- 13. Engine control cable
- 14. Intake pipe, vacuum hose and fuel pipe
- 15. Radiator hose and heater hose
- 16. Engine cover
- 17. Battery cable and electrical cable

Important operations — Removal

1. Battey cable and electrical cable

Disconnect the cables.



2. Engine cover

1. Raise the companion's seat.
2. Remove the driver seat cushion, then remove the engine cover.

3. Radiator hose and heater hose

When the engine and radiator are filled with long life coolant, drain and keep the coolant in a clean container.

14. Engine foot bracket

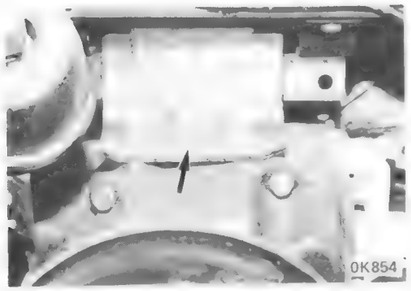
Support the engine on a transmission jack.

Refer to transmssion and clutch workshop manuals for removal procedure.

16. Engne with transmission

Removal of transmission assembly and clutch.

Important operations — Installation

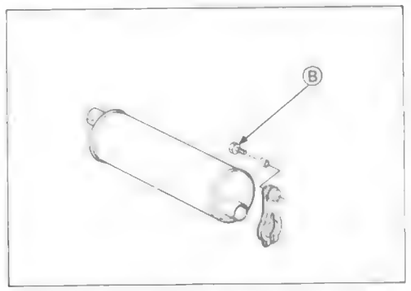


3. Transmission mount bracket

Torque	(kg-m)	2.8 — 4.7

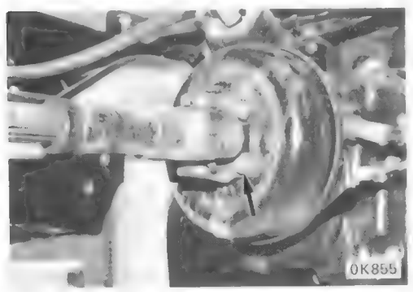
4. Engine foot bracket

Torque	(kg-m)	2.8 — 4.7



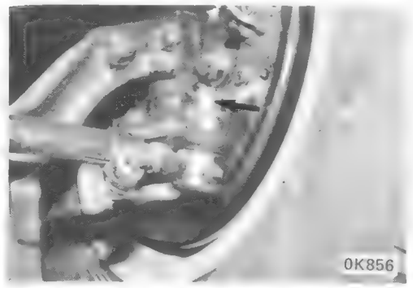
5. Exhaust pipe bracket

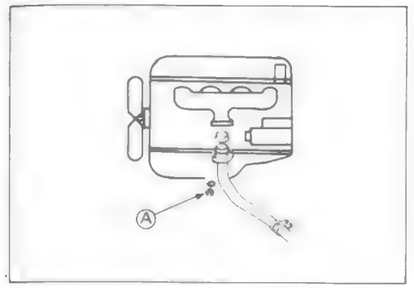
Torque	(kg-m)	1.7



6. Propeller shaft

Torque	(kg-m)	4 — 6





11. Tie rod

Torque	(kg-m)	6 — 9

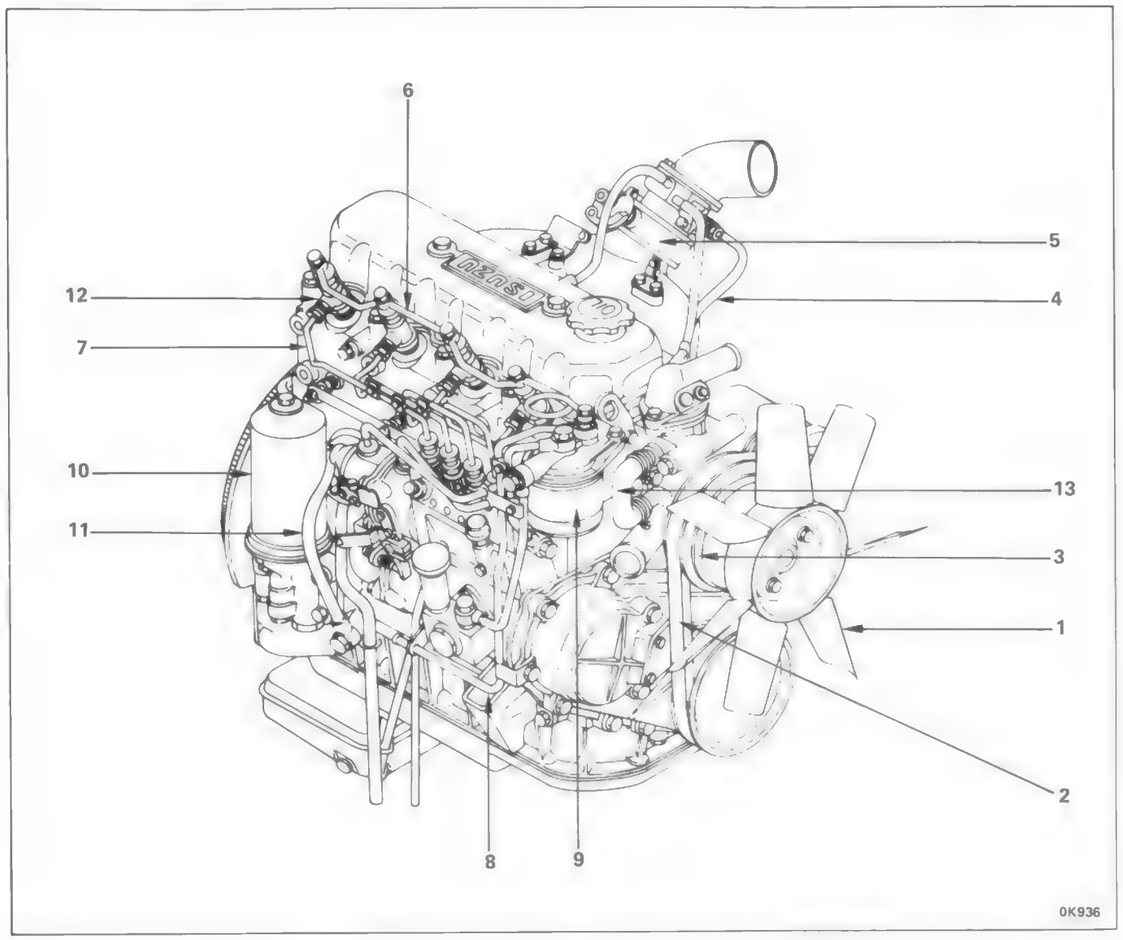
12. Exhaust pipe

Torque	(kg-m)	3.8

DISASSEMBLY

EXTERNAL PARTS (Right hand side) I

This illustration is based on the C240 model.

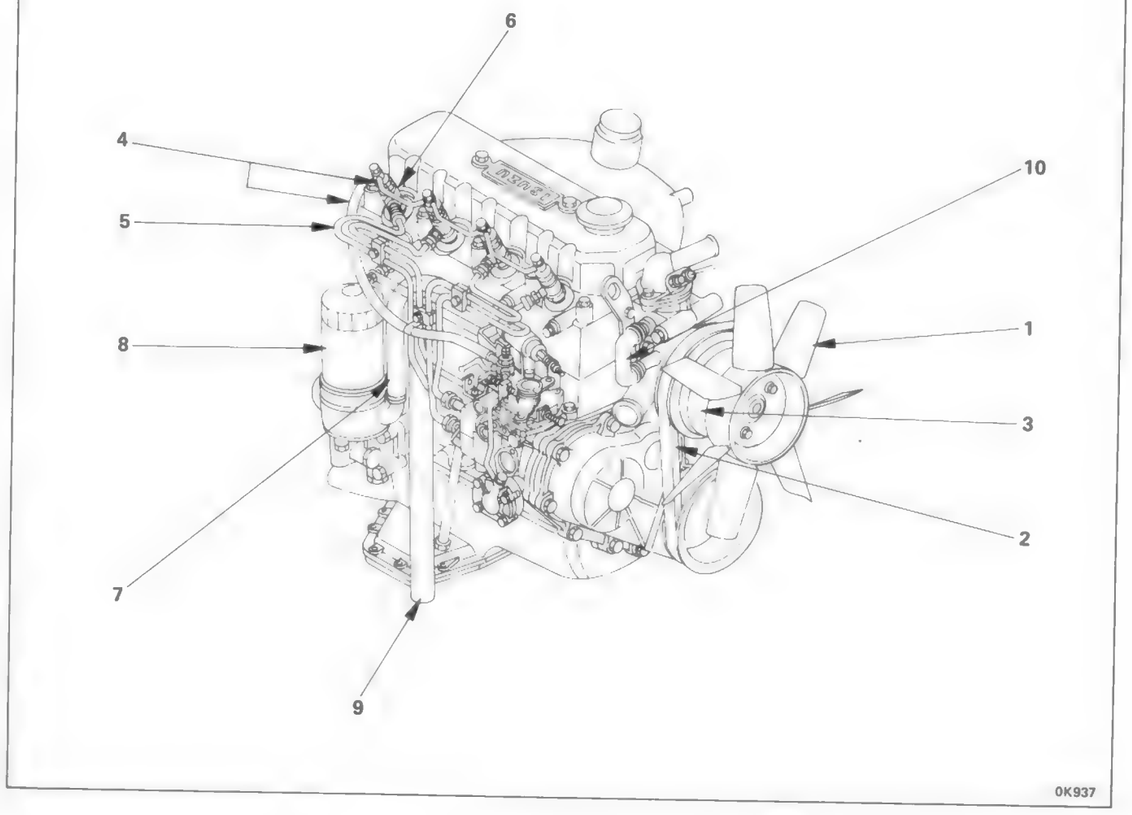


Disassembly steps

1. Cooling fan
2. Fan belt
3. Fan pulley
4. Vacuum hose
5. Intake shutter and throttle valve
6. Leak off pipe
7. Injection pipe
8. Fuel pipe
9. Fuel filter
10. Oil filter
11. Oil pipe : Oil gallery to vacuum pump
12. Injection nozzle
13. Water hose

EXTERNAL PARTS (Right hand side) II

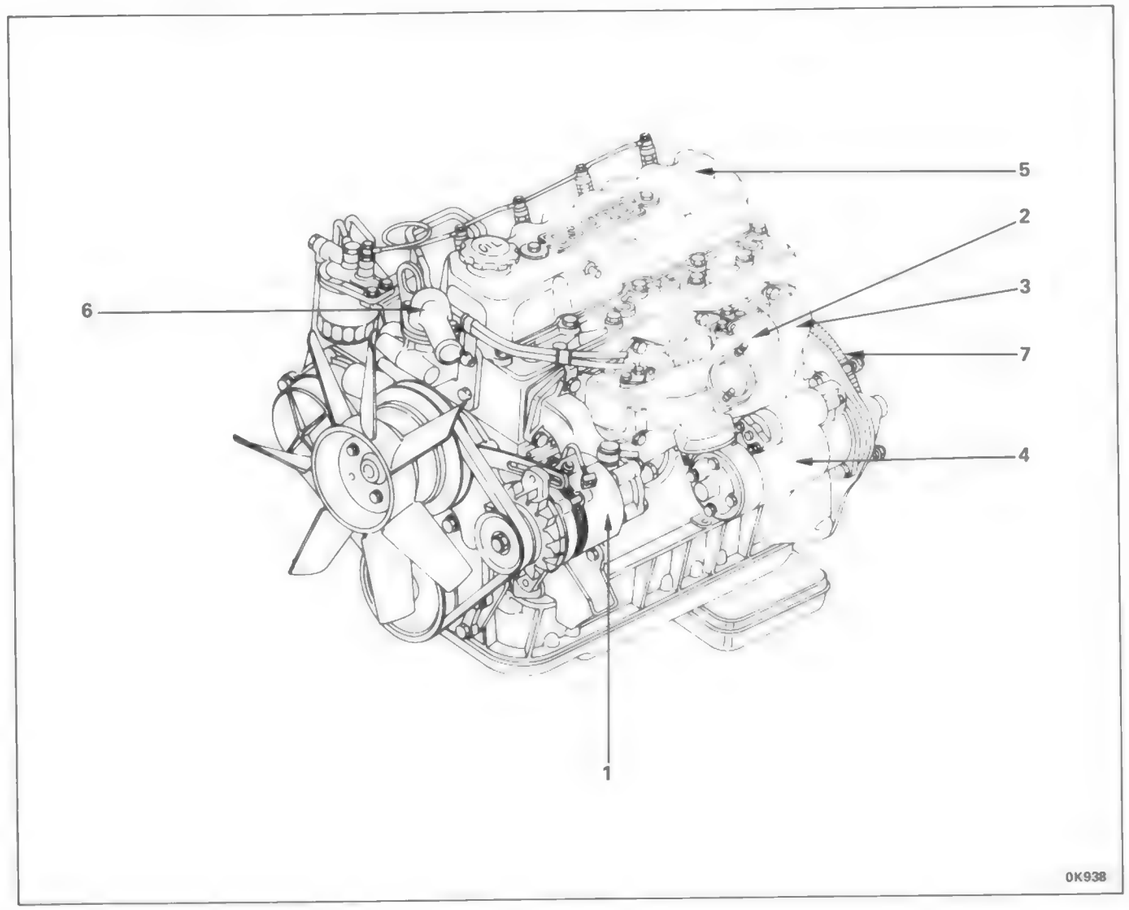
This illustration is based on the C190GB model.



Disassembly steps

1. Cooling fan and spacer
2. Fan belt
3. Fan pulley
4. Leak off pipe
5. Injection pipe
6. Injection nozzle
7. Water hose
8. Oil filter assembly
9. Air breather hose
10. Water hose

EXTERNAL PARTS (Left hand side)



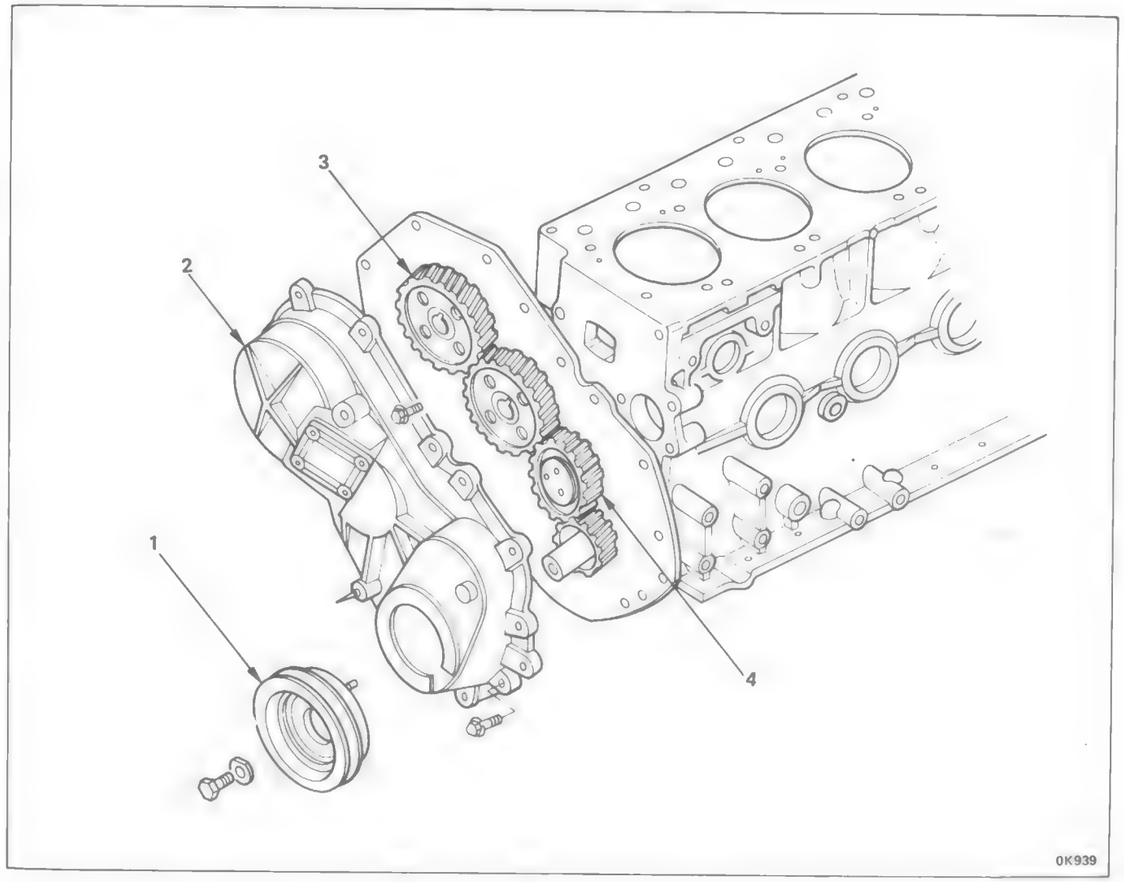
Disassembly steps

1. Generator assembly
2. Intake manifold
3. Exhaust manifold
4. Starter motor
5. Head cover
6. Thermostat housing
7. Flywheel

INTERNAL PARTS (Timing gear train)

MAJOR COMPONENTS

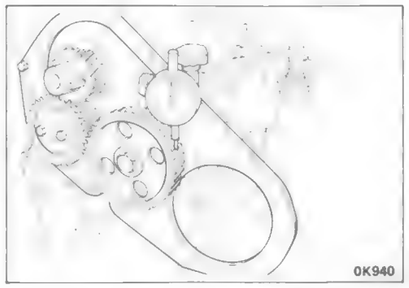
Gear drive type



Disassembly steps

1. Pulley
2. Timing gear case cover
▲3. Injection pump gear
▲4. Idler gear

Important operations

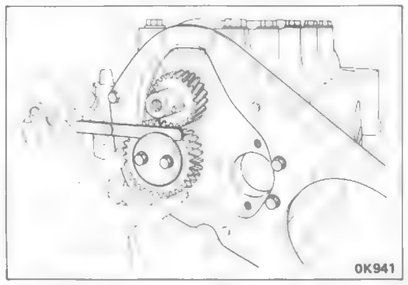


3. Injection pump assembly

Inspect the following items before timing gear removal.
Backlash (crankshaft gear, idler gear, camshaft gear, injection pump gear).

(mm)

Standard	Limit
0.10 — 0.17	0.3



4. Idler gear end play

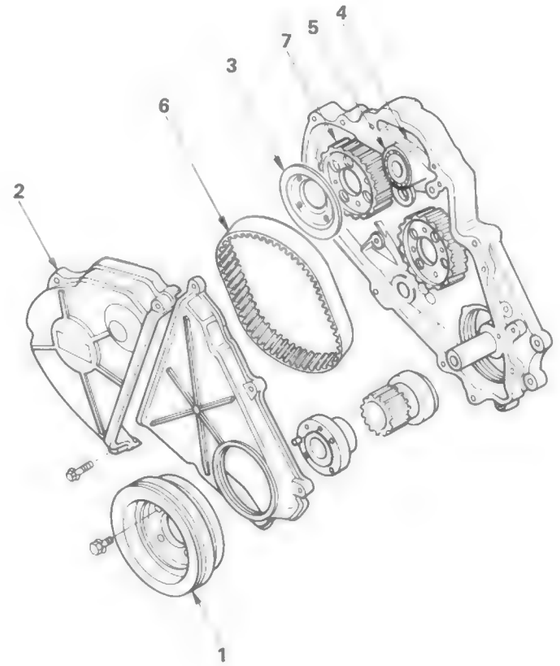
(mm)

Standard	Limit
0.07	0.2

INTERNAL PARTS (Timing gear train)

MAJOR COMPONENTS

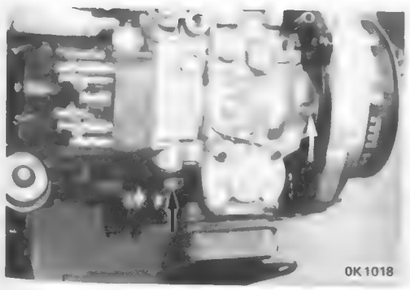
Belt drive type



Disassembly steps

1. Pulley
2. Pulley housing cover
3. Injection pump timing pulley flange
4. Tension spring
5. Tension bearing and center
6. Timing belt
▲7. Injection pump gear

Important operation

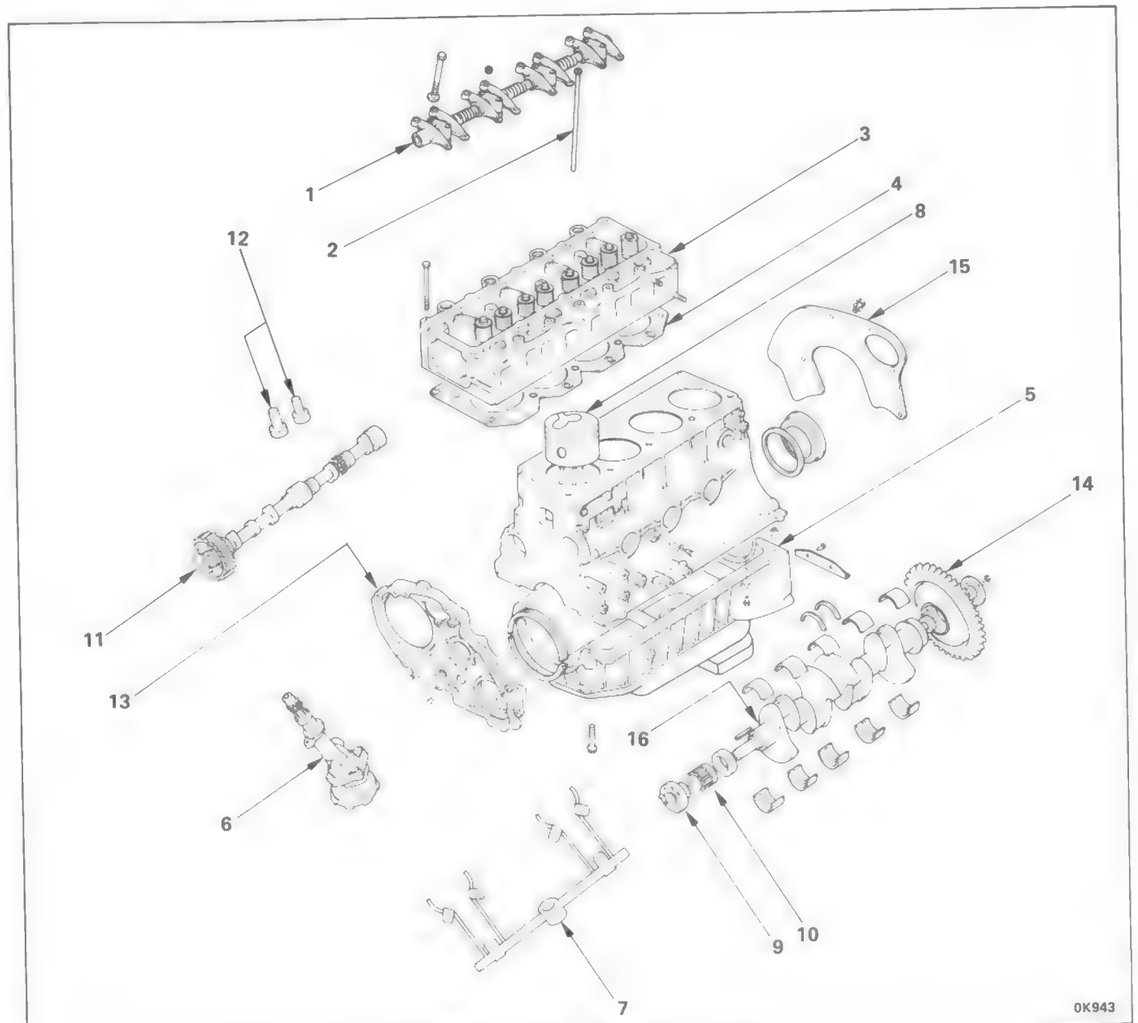


7. Injection pump gear

Remove the injection pump front bracket and rear bracket.

INTERNAL PARTS

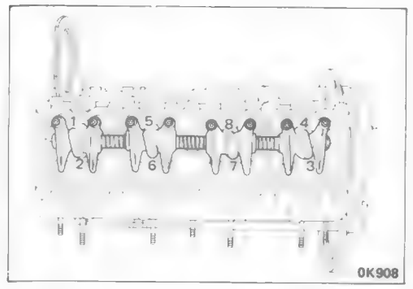
MAJOR COMPONENTS



Disassembly steps

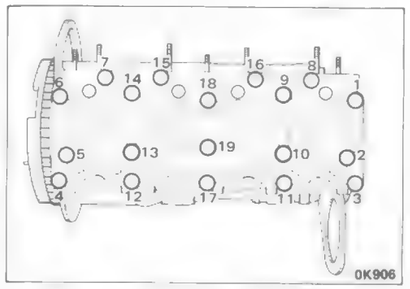
- ▲1. Rocker arm shaft bracket and shaft
- 2. Push-rod
- ▲3. Cylinder head
- 4. Cylinder head gasket
- 5. Crankcase
- 6. Oil pump
- 7. Oiling jet
- 8. Piston
- 9. Crankshaft pulley center (C190GB, C190KE)
- ▲10. Crankshaft timing pulley (C190GB, C190KE)
- ▲11. Camshaft assembly
- 12. Tappet
- 13. Timing pulley housing (C190GB, C190KE)
- 14. Flywheel
- 15. Rear plate
- ▲16. Crankshaft assembly

Important operations



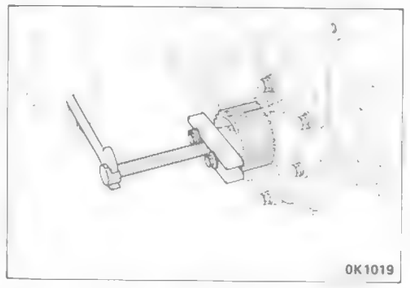
1. Rocker arm bracket and shaft

Loosen rocker arm shaft bracket bolts in numerical order.



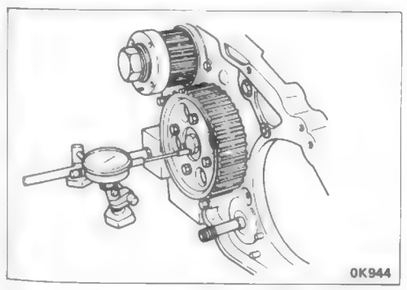
3. Cylinder head

Loosen cylinder head bolts in numerical order.



10. Crankshaft timing pulley (C190GB, C190KE)

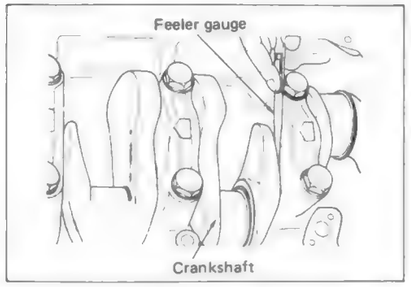
Remover : 5-85210-016-0



11. Camshaft end play (C190GB, C190KE)

(mm)

Standard	Limit
0.08	0.2

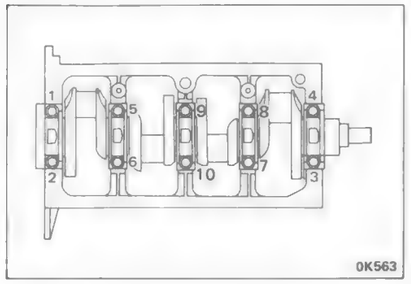


16. Crankshaft assembly

Check the crankshaft end play before disassembly.

(mm)

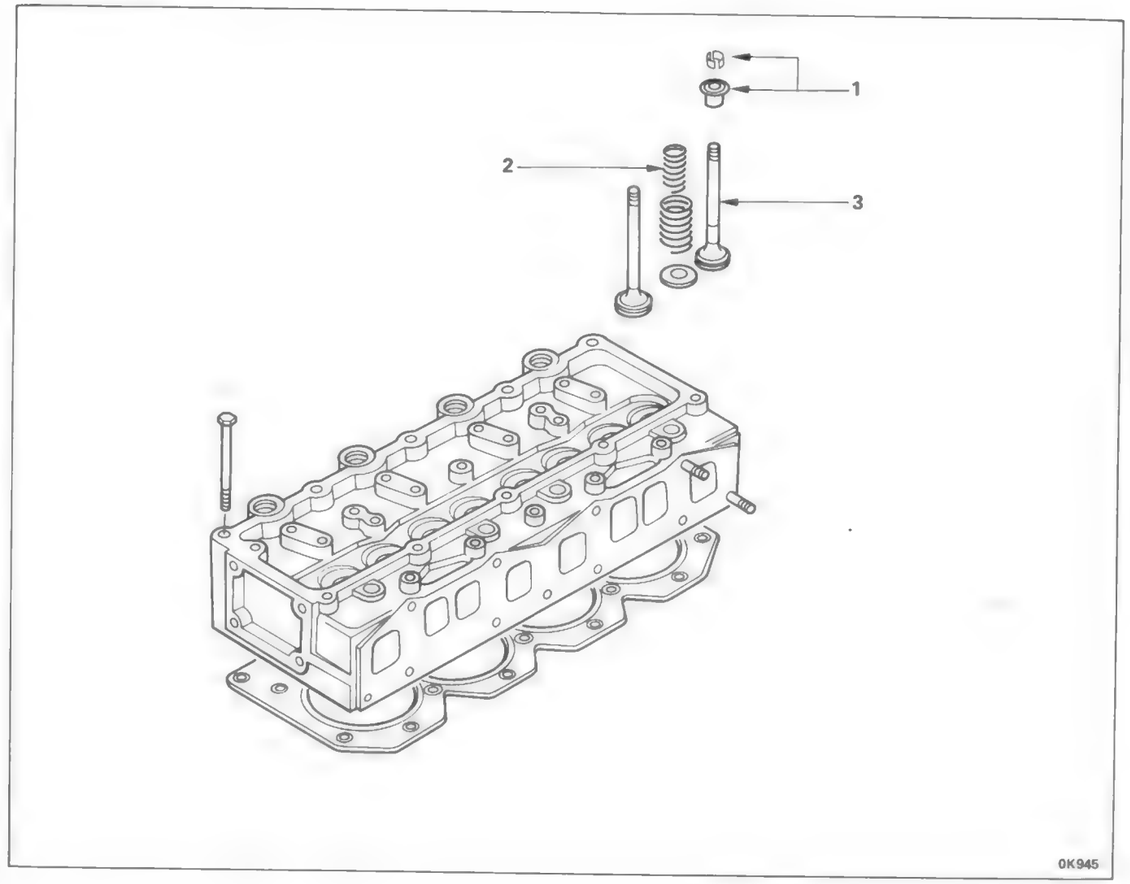
Standard	Limit
0.1	0.3



Cranshaft bearing cap bolts.
Loosen bearing cap bolts in numerical order.

MINOR COMPONENTS

CYLINDER HEAD

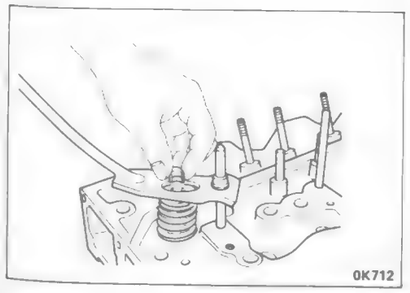


Disassembly steps

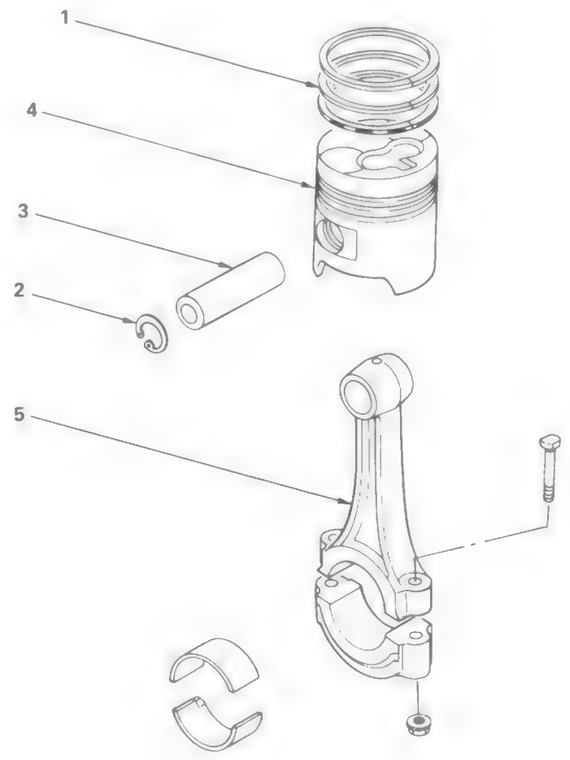
- ▲1. Spring seat and split key
- 2. Valve spring
- 3. Valve

Important operation

1. Spring seat and split key
Compressor : 9-8523-1423-0



PISTON AND CONNECTING-ROD ASSEMBLY

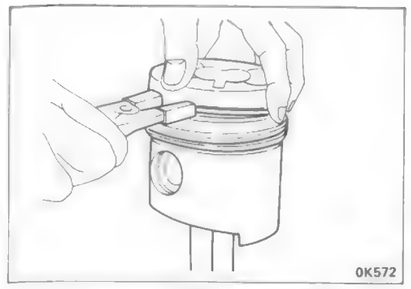


0K571

Disassembly steps

- ▲1. Piston ring
- 2. Snap ring
- ▲3. Piston pin
- 4. Piston
- 5. Connecting-rod

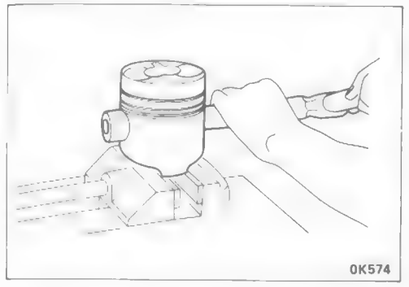
Important operations



0K572

1. Piston ring

Remover

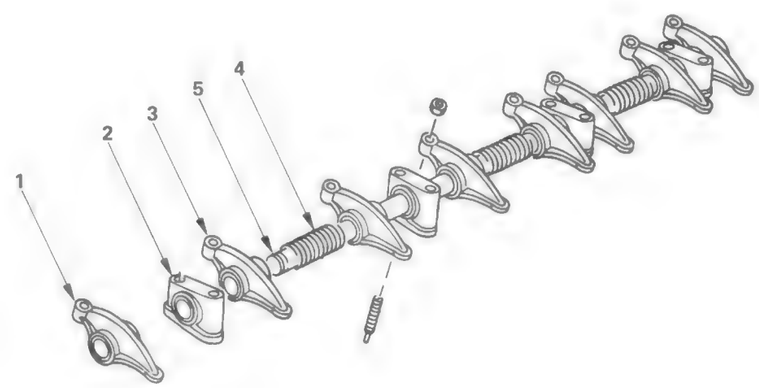


0K574

3. Piston pin

Drive out the piston pin using a brass rod at normal temperature.

ROCKER ARM AND SHAFT ASSEMBLY



0K946

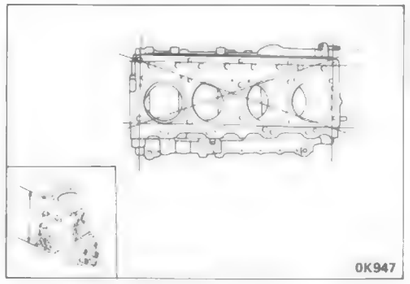
Disassembly steps

1. Rocker arm (A)
2. Rocker arm shaft bracket
3. Rocker arm (B)
4. Rocker arm shaft spring
5. Rocker arm shaft

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

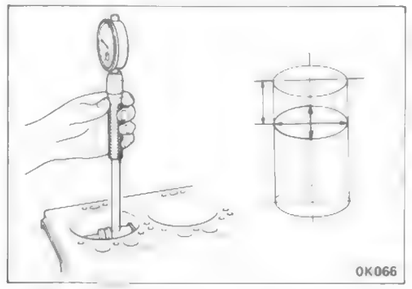
CYLINDER BODY AND LINER



Cylinder body warpage

(mm)

		Standard	Limit
Overall length		0.05	0.2
Thickness	C190	247.97—248.03	247.72
	C240	247.97—248.03	247.77

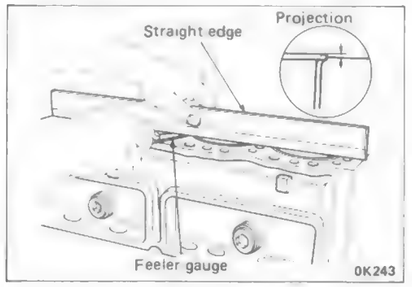


Cylinder liner bore diameter

Measuring point : Approx. 15mm bellow upper face.

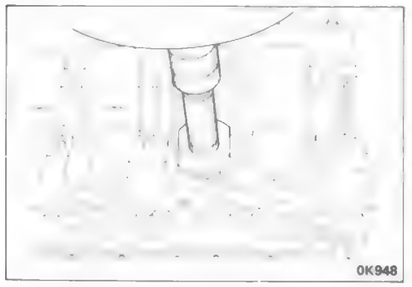
(mm)

Standard	Limit
86.02 — 86.06	86.10



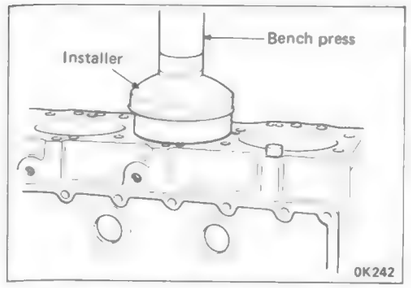
Amount of projection

Standard	(mm)	0 — 0.1



Cylinder liner replacement

Remover : 9-8523-2552-0
Liner grip : 9-8522-1148-0

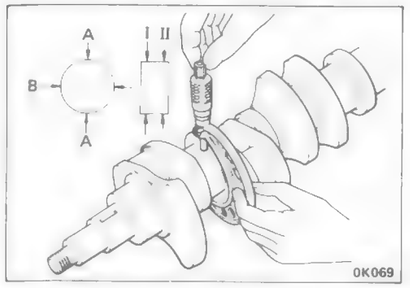


Installer : 9-8523-2551-0

Wipe clean the cylinder liner and cylinder body to remove oil, then install the cylinder liner into cylinder bore using a bench press.
The use of dry ice to cool the cylinder liner will invite contraction, facilitating smooth installation of the cylinder liner.

Tighteness	(mm)	0 — 0.02

CRANKSHAFT AND BEARING



Crankshaft journal and pin diameter

C190GB, C190KE, C190

(mm)

	Standard
Journal	59.92 — 59.93
Pin	52.92 — 52.93

C240

(mm)

	Standard
Journal	69.92 — 69.93
Pin	52.92 — 52.93

Undersize bearings are available in 4 different sizes which include 0.25, 0.5, 0.75 and 1.0 mm undersizes.

Crankshaft diameter when using undersize bearing

C190GB, C190KE, C190

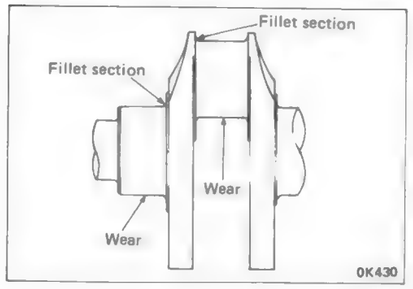
(mm)

	Journal	Pin
U/S 0.25	59.67 — 59.68	52.67 — 52.68
U/S 0.50	59.42 — 59.43	52.42 — 52.43
U/S 0.75	59.17 — 59.18	52.17 — 52.18
U/S 1.00	58.92 — 58.93	51.92 — 51.93

C240

(mm)

	Journal	Pin
U/S 0.25	69.67 — 69.68	52.67 — 52.68
U/S 0.50	69.42 — 69.43	52.42 — 52.43
U/S 0.75	69.17 — 69.18	52.17 — 52.18
U/S 1.00	68.92 — 68.93	51.92 — 51.93



Uneven wear

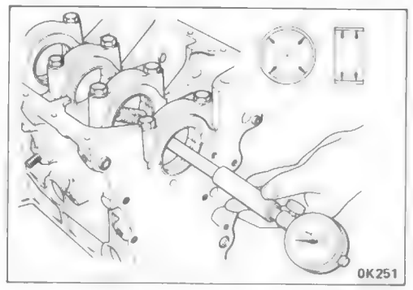
(mm)

	Standard	Limit
Journal	0.001	0.05
Pin	0.001	0.05

Curvature of the fillet section on the crankshaft journals and crankpins should be finished as shown below.

(mm)

	Standard
Journal	3.3 — 3.7
Pin	3.3 — 3.7



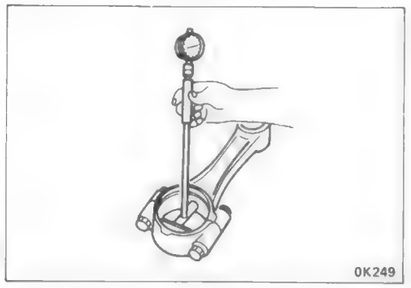
Clearance between crankshaft journal and crankshaft bearing

(mm)

	Standard	Limit
C190GB, C190KE, C190	0.029 — 0.085	0.12
C240	0.018 — 0.065	0.12

Crankshaft bearing cap bolt.

Torque (kg-m)	16 — 18



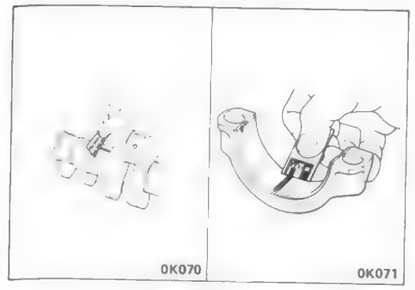
Clearance between crankpin and connecting-rod bearing

(mm)

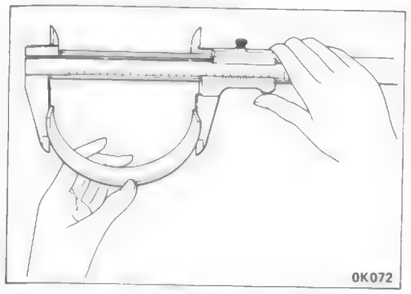
	Standard	Limit
C190GB, C190KE, C190	0.029 — 0.085	0.12
C240	0.018 — 0.065	0.12

Connecting-rod cap nut.

Torque (kg-m)	8 — 9



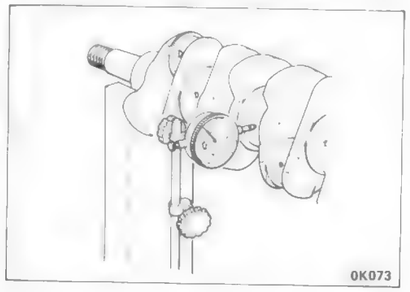
The clearance can also be measured using a plastigage.



Bearing spread

(mm)

	Models	Limit
Crankshaft bearing	C190GB, C190KE, C190	64.5
	C240	74.5
Connecting-rod bearing	C190GB, C190KE, C190	56.5
	C240	56.5



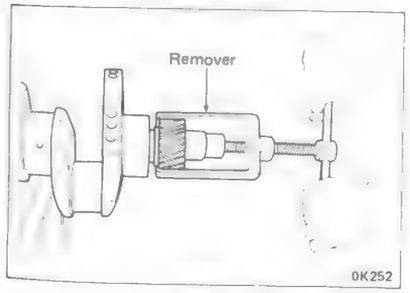
Run-out

(mm)

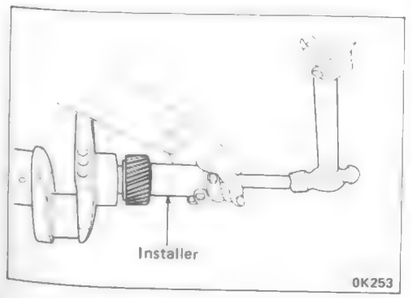
Standard	Limit
0.03	0.06

Crankshaft gear replacement (C190, C240)

Removal

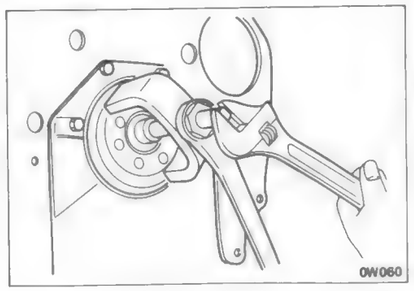


Remover : 9-8521-0074-0



Installation

Installer : 9-8522-0021-0

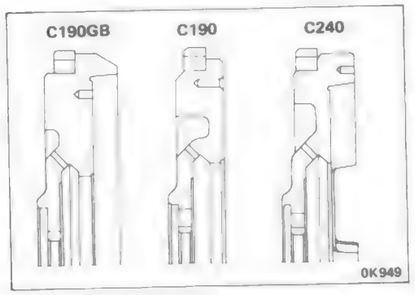


Pilot bearing replacement

Remover : 9-8523-1812-0

FLYWHEEL

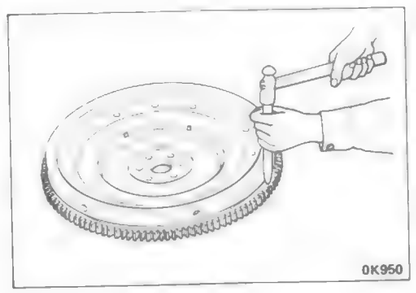
Inspect the following parts for wear, damage or other abnormal conditions.



Depth and thickness

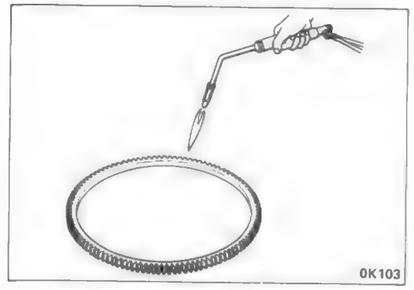
(mm)

	Standard	Limit
C190GB, C190KE	17.9 — 18.1	19.0
C190	32.9 — 33.0	32.0
C240	17.9 — 18.1	19.0



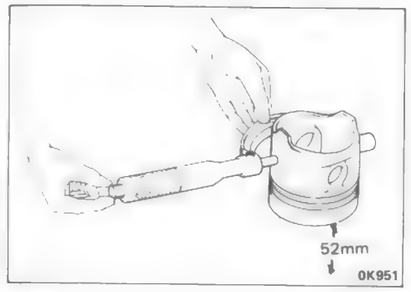
Ring gear replacement

Remove the ring gear from the flywheel by tapping around the side face of the gear with a brass bar.



Heat the ring gear evenly with a gas burner (Maximum temperature 200°C) to invite volumetric expansion. Install the ring gear on the flywheel when it is sufficiently heated.

PISTON



Piston clearance

Piston outside diameter

Take measurement in direction at a right angle to the piston pin hole.

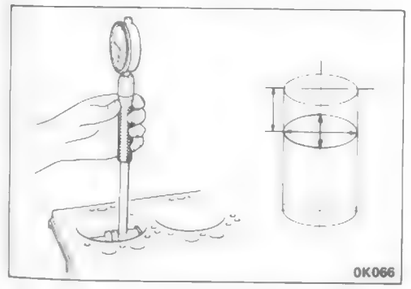
Grading position : 52mm

The piston grade should be selected by referring to the following table, so that specified piston clearance can be obtained.

Piston outside diameter

(mm)

Piston mark	Standard
A	85.888 — 85.907
C	85.908 — 85.927

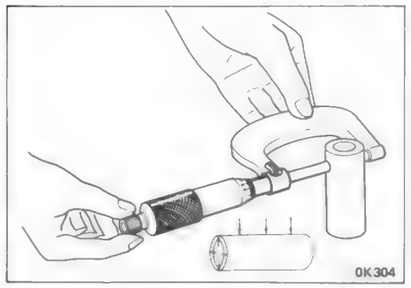


Cylinder liner inside diameter

(mm)

	Standard
Cylinder liner inside diameter	86.02 — 86.06
Piston clearance	0.123 — 0.143

C190KE model engine is not equipped with cylinder liner therefore, Oversize pistons and piston rings are prepared for repair.



Piston pin outside diameter

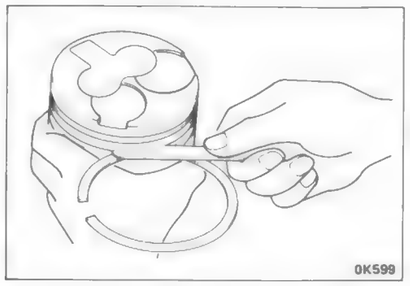
(mm)

Standard	Limit
27.0 — 26.995	26.96

Fitting interference between piston pin and piston.

(mm)

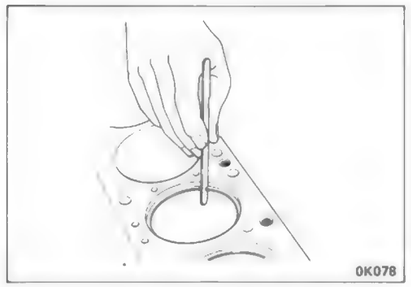
Standard	0 — 0.005



Clearance between piston ring and ring groove

(mm)

	Standard	Limit
1st compression ring	0.09 — 0.11	0.3
2nd compression ring	0.03 — 0.06	0.3
Oil ring	0.02 — 0.05	0.15

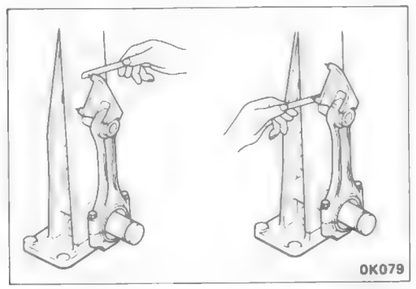


Piston ring gap

(mm)

	Standard	Limit
1st compression ring	0.20 — 0.40	2.0
2nd compression ring	0.20 — 0.40	2.0
Oil ring	0.1 — 0.3	2.0

CONNECTING-ROD



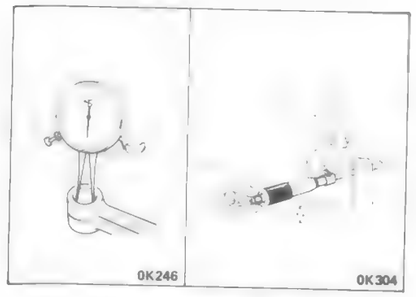
Connecting-rod

Distortion and parallelism

(Per length of 100mm)

(mm)

	Standard	Limit
Distortion	0.08	0.20
Parallelism	0.05	0.15

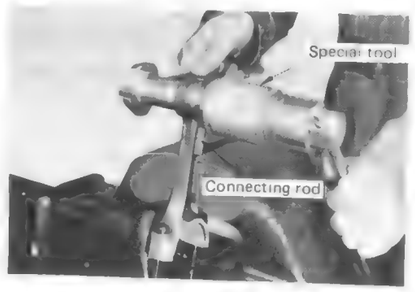


Bushing

Clearance between bushing and piston pin.

(mm)

Standard	Limit
0.008 — 0.02	0.05



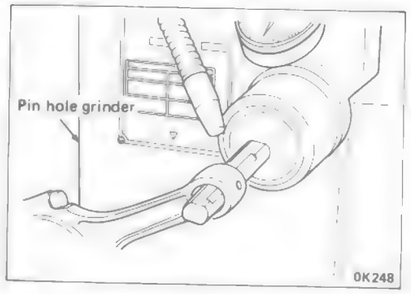
Bushing replacement

Removal

Remover : 9-8523-1369-0

Installation

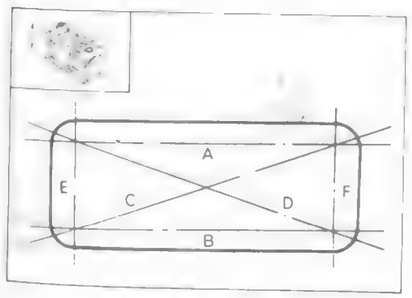
Installer : 9-8523-1369-0



The inner face of the bushing must be finished with a remmer after installation of the bushing.

Inside diameter (mm)	27.008 — 27.015

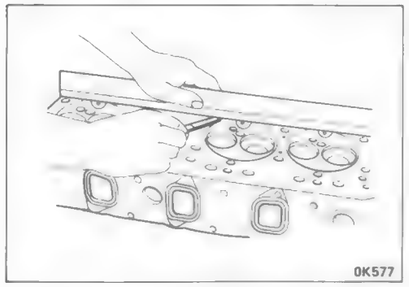
CYLINDER HEAD



Cylinder head warpage

(mm)

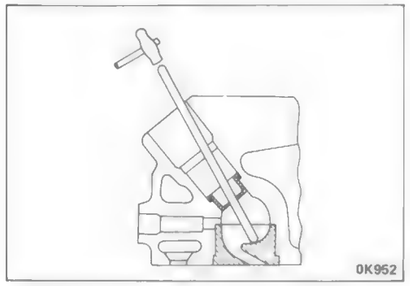
	Standard	Limit
Overall length	0.05	0.2
Thickness	91.95 — 92.05	91.75



Depression of hot plugs

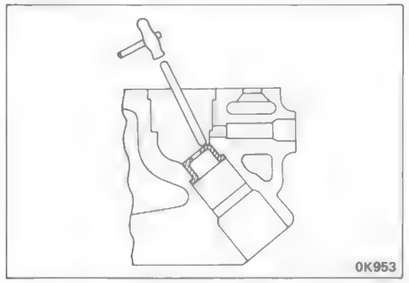
Check the amount of depression of hot plugs on No. 1 through No. 4 cylinders using a feeler gauge, with a straight edge held against the hot plug face.

Limit	(mm)	0.02



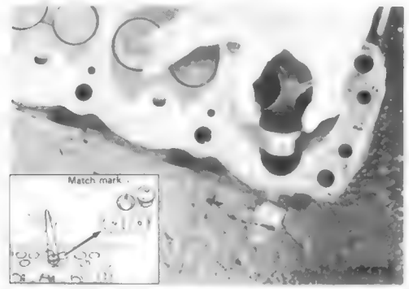
Hot plug replacement

Remove the hot plug in the following manner: Insert a suitable round bar sizing 3 to 5mm in diameter into nozzle holder fitting hole to touch the hot plug, then drive out the hot plugs using a hammer.



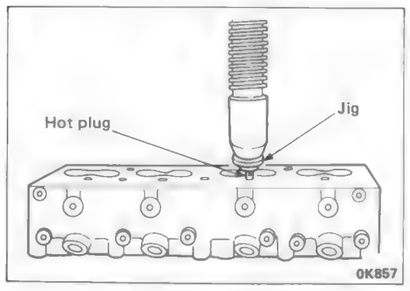
Heat shield replacement

Drive out the heat shield using a brass bar and hammer.

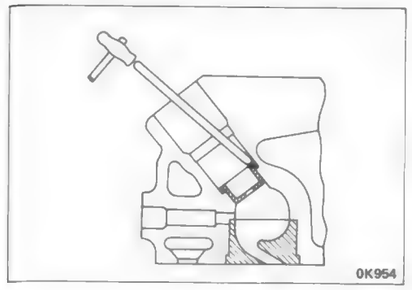


Installation of new hot plug

Install lock ball into groove in hot plug. Drive the hot plug into cylinder head by aligning lock ball in hot plug with groove in cylinder head.



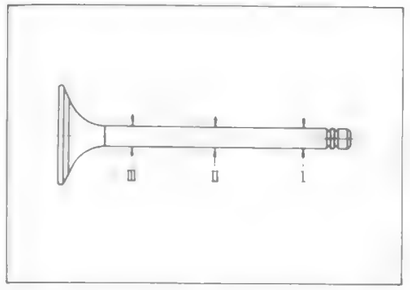
Press the hot plug into position by applying 4500 to 5000kg pressure using a bench press with a piece of metal fitted against the hot plug face for protection.
After installation, grind the face of hot plug flush with the face of the cylinder head.



Installation of new heat shield

Install the heat shield with the flanged side up on the cylinder head by tapping on the flange lightly with a brass bar.

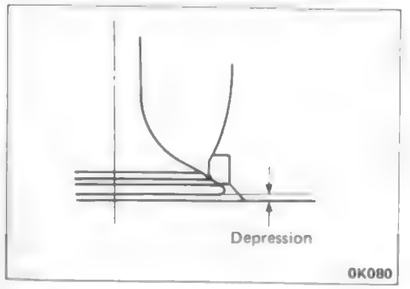
VALVE AND VALVE SEAT INSERT



Valve stem diameter

(mm)

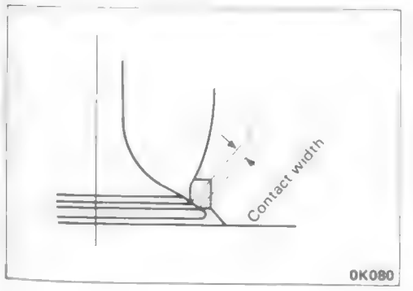
	Standard	Limit
Intake valves	7.949 — 7.961	7.88
Exhaust valve	7.921 — 7.936	7.85



Depression

(mm)

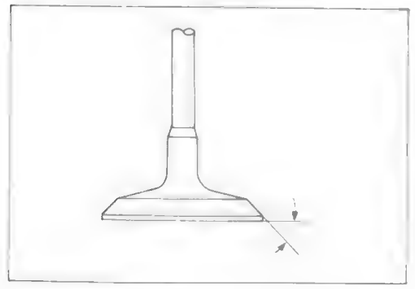
	Standard	Limit
Intake valves	0.7	2.5
Exhaust valves	0.7	2.5



Contact width

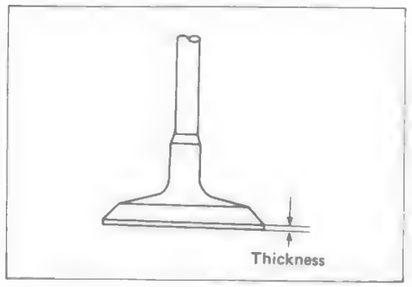
(mm)

Standard	Limit
1.2 — 1.5	3.6



Valve seating angle

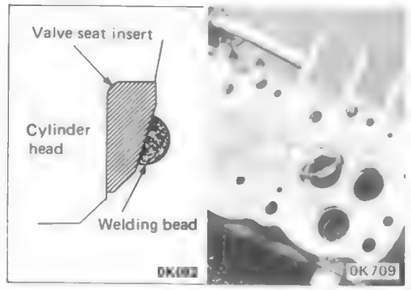
Valve seating angle	45°



Valve seat thickness

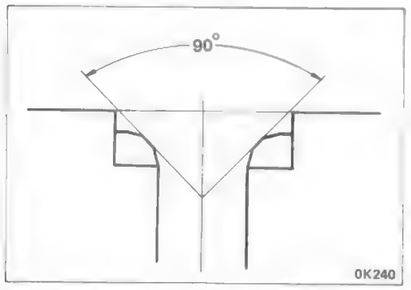
(mm)

	Standard	Limit
Intake valves	1.3	1.0
Exhaust valves	1.3	1.0



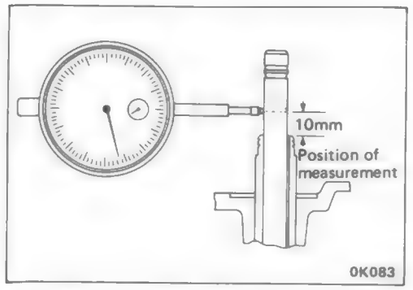
Valve seat insert replacement

Arc-weld excess metal around inner face of the valve seat insert and allow to cool off a few minutes, then pry off the valve seat insert with screw drivers.



Press a new valve seat insert into the bore using a bench press. After installation of the valve seat insert, grind finish the seating face with a seat grinder carefully noting the seating angle, contact width and depression. Lap the valve and seat as the final step.

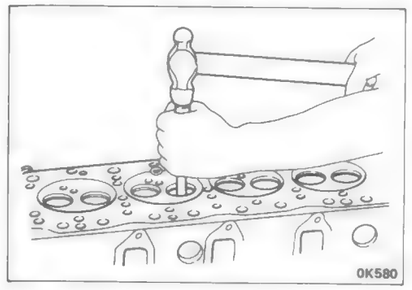
VALVE GUIDE



Clearance between valve stem and valve guide

(mm)

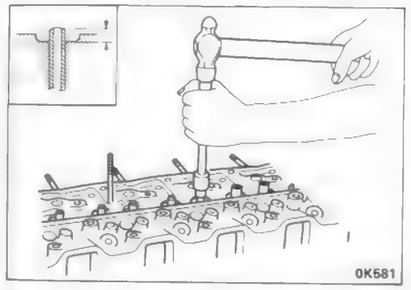
	Standard	Limit
Intake valves	0.039 — 0.068	0.20
Exhaust valves	0.064 — 0.093	0.25



Valve guide replacement

Removal

Remover : 5-85230-002-0



Installation

Apply engine oil to the outer circumference of the valve guide. Set the installer to the valve guide, then drive the guide into position from the upper face of the cylinder head using a hammer.

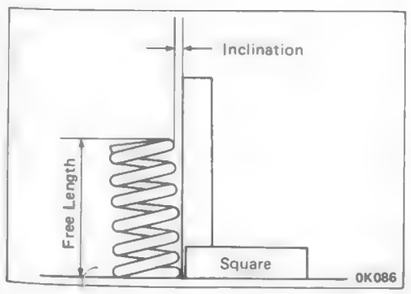
(mm)

Height of valve guide upper end from cylinder head upper face	Intake side	13.0
	Exhaust side	14.0

Valve guide installer : 5-85230-002-0

Discard used oil seals and install new ones.

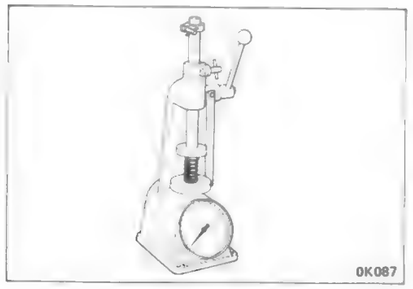
VALVE SPRING



Free length and inclination

(mm)

		Standard	Limit
Free length	Inner	47.9	46.5
	Outer	47.3	45.8
Inclination	Inner	—	1.0
	Outer	—	1.0

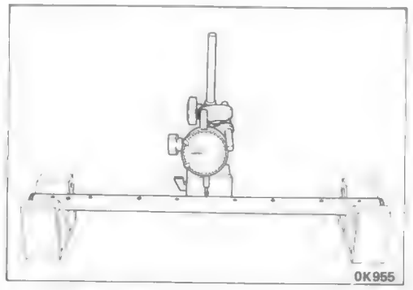


Spring tension

(kg)

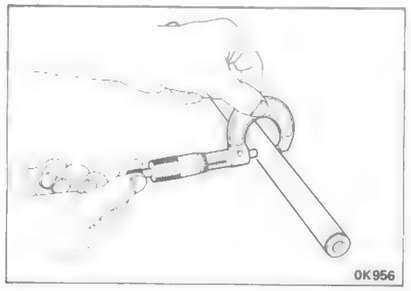
	Set length	Standard	Limit
Inner	37.0mm	5.55 — 6.25	5.02
Outer	39.0mm	19.65 — 22.15	18.1

ROCKER ARM SHAFT AND ROCKER ARM ASSEMBLY



Run-out

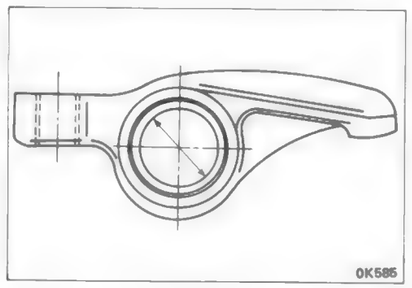
	Limit (mm)	0.6



Rocker arm shaft diameter

(mm)

Standard	Limit
18.98 — 19.00	18.85



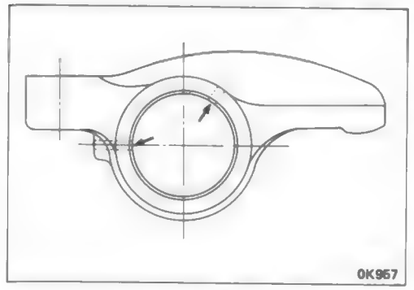
Rocker arm

Clearance between rocker arm shaft and rocker arm.

(mm)

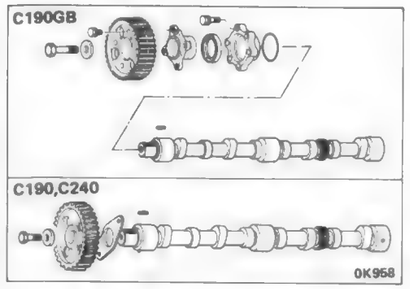
Standard	Limit
0 — 0.04	0.2

If the amount of wear is beyond the limit, replace either the shaft or rocker arms depending on the condition of wear.

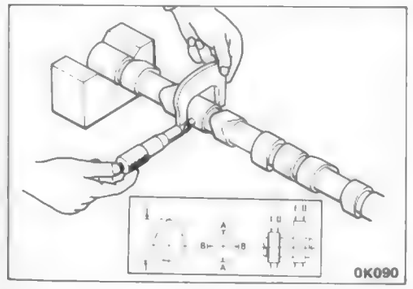


It is necessary to drill an oil port in the new rocker arm bushing as it is not provided with oil port.

CAMSHAFT ASSEMBLY



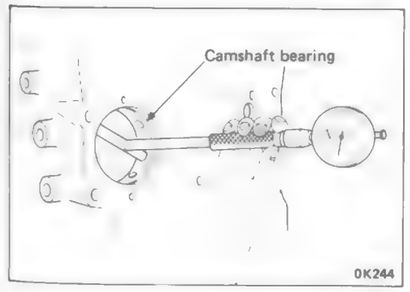
Difference between parts for models C190GB, C190 and C240.



Camshaft diameter and height of cam lobe.

(mm)

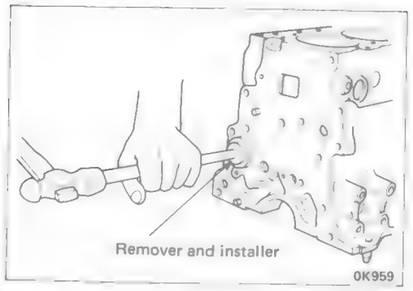
	Standard	Limit
Journal diameter	47.94 — 47.97	47.6
Height of cam lobe	40.57	40.2



Clearance between camshaft and bearing

(mm)

Standard	Limit
0.05	0.12



Cam bearing replacement

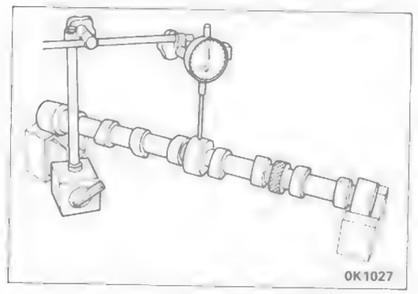
Removal

Remover and installer : 9-8523-1737-0 or
9-8523-1360-0

Installation

The oil port in the cylinder body must be aligned with that in the camshaft bearing.

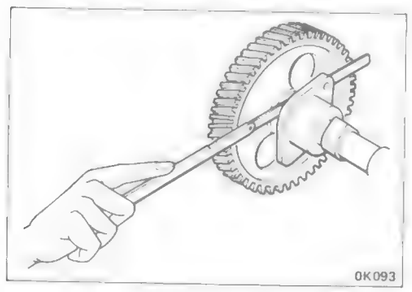
Remover and installer : 9-8523-1737-0 or
9-8523-1360-0



Run out

(mm)

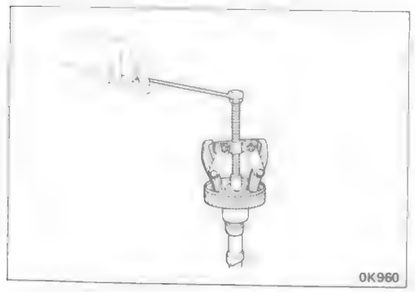
Standard	Limit
0.05	0.1



End play (C190, C240 only)

(mm)

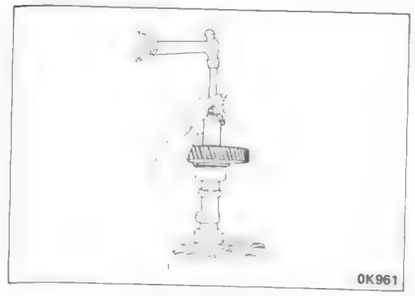
Standard	Lmit
0.05 — 0.11	0.2



Camshaft gear replacement (C190, C240 only)

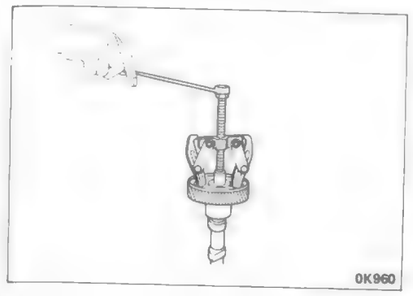
Removal

Remover : 5-85210-002-0



Installation

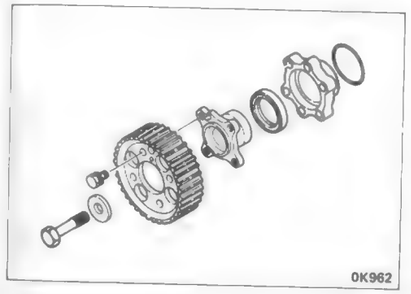
Drive the gear to the shaft aligning the key groove on the gear with the key on the shaft.



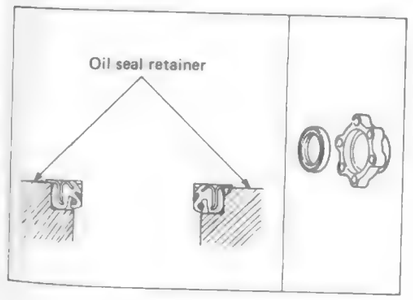
C190GB only

Removal

Remover : 5-85210-002-0



Inspect the following parts for wear, damage or other abnormal conditions

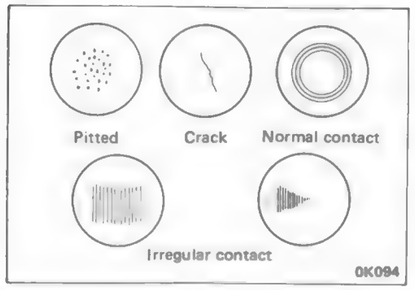


Oil seal replacement

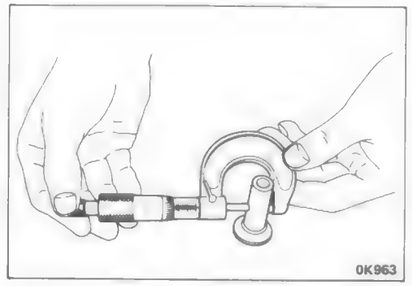
Remover
Drive out the oil seal using a brass bar against the side with boss.

Installation
Install the oil seal flush with the retainer face.

TAPPET



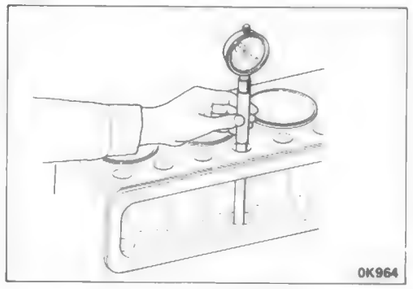
Inspect tappet for wear, damage or other abnormal condition.



Diameter

(mm)

Standard	Lmit
12.98 — 12.99	12.95

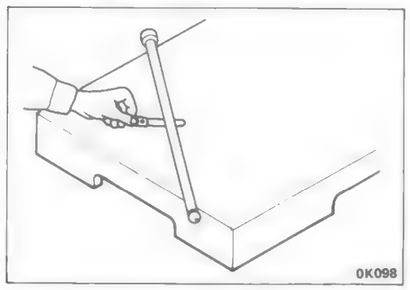


Clearance between tappet and cylinder body

(mm)

Standard	Lmit
0.03	0.1

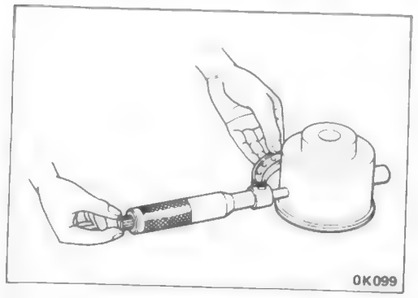
PUSH-ROD



Run-out

Limit (mm)	0.3

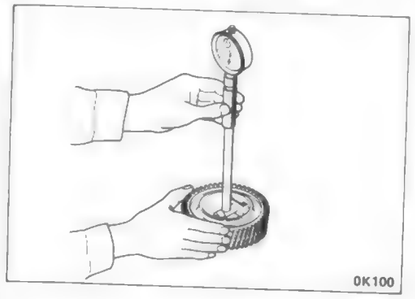
IDLER GEAR AND SPINDLE (C190, C240 only)



Spindle diameter

(mm)

Standard	Limit
44.945 — 44.975	44.845



Clearance between spindle and idler gear

(mm)

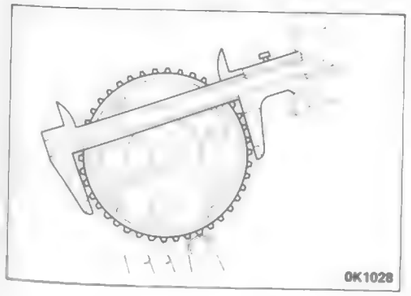
Standard	Limit
0.025 — 0.085	0.2

TIMING PULLEY (C190GB only)

Crankshaft timing pulley outside diameter

(mm)

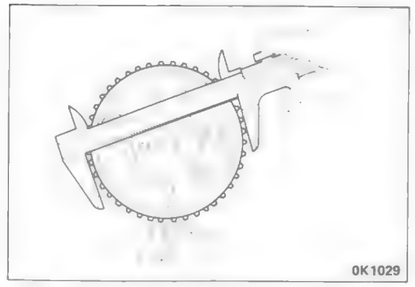
Standard	Limit
65.33 — 65.43	65.230



Camshaft pulley outside diameter

(mm)

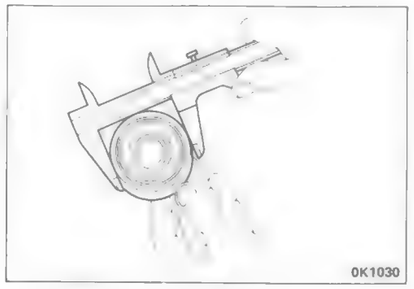
Standard	Limit
132.032 — 132.152	131.932



Injection pump pulley outside diameter

(mm)

Standard	Limit
132.032 — 132.152	131.932

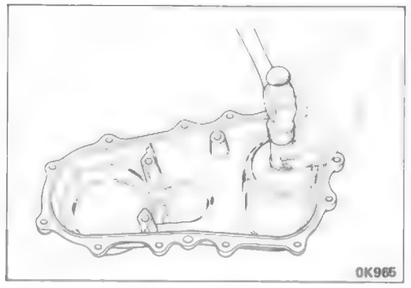


Tention bearing outside diameter

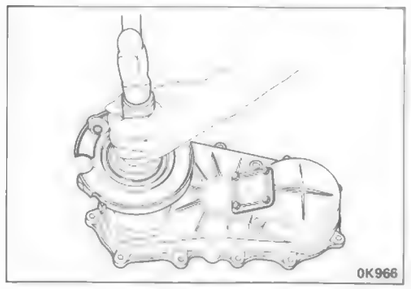
(mm)

Standard	Limit
61.8 — 62.0	61.6

Timing gear case cover oil seal replacement (C190, C240)



Removal



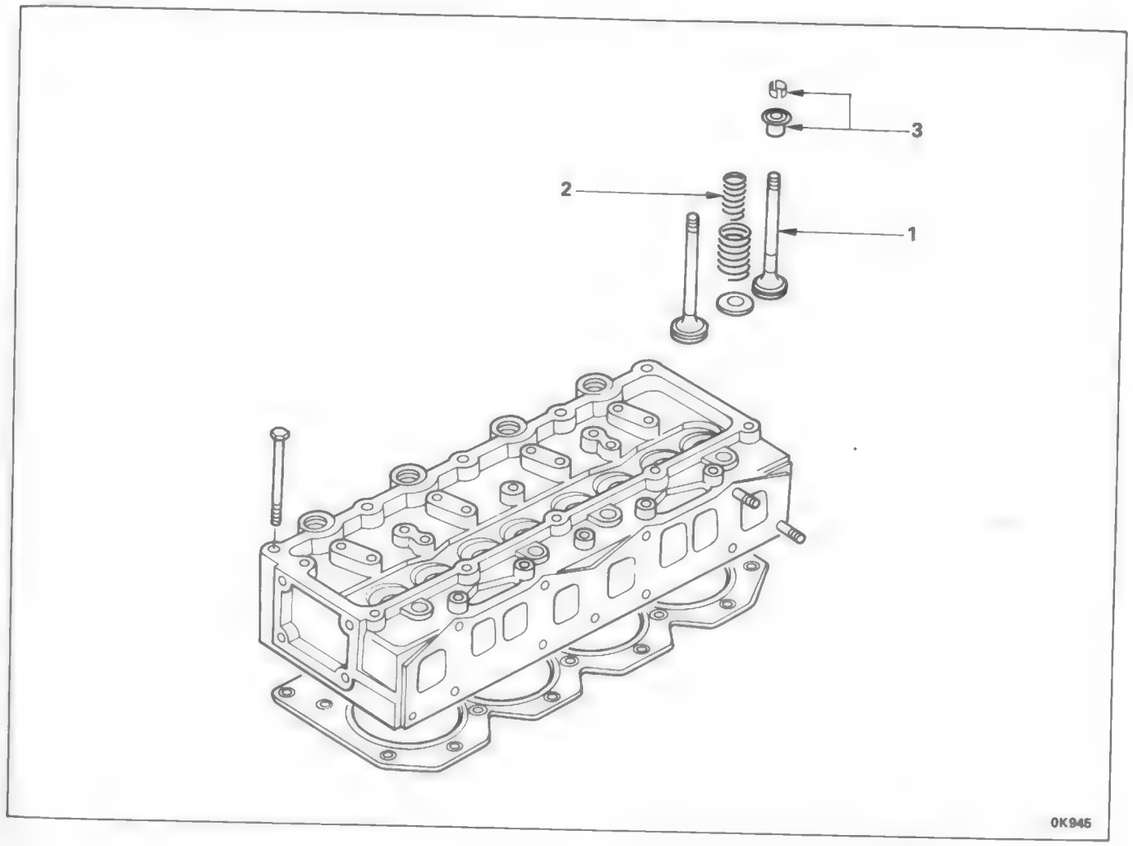
Installation

Installer : 5-85220-013-0

REASSEMBLY

MINOR COMPONENTS

CYLINDER HEAD



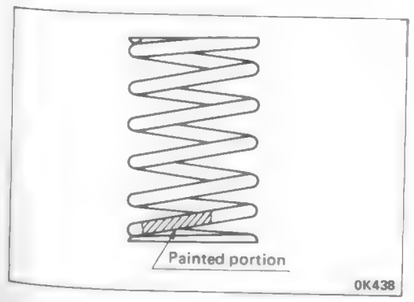
Reassembly steps

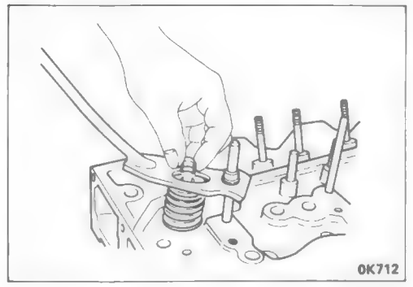
1. Valve
▲2. Valve spring
▲3. Spring seat and split key

Important operations

2. Valve spring

Install the valve springs with the painted end down.

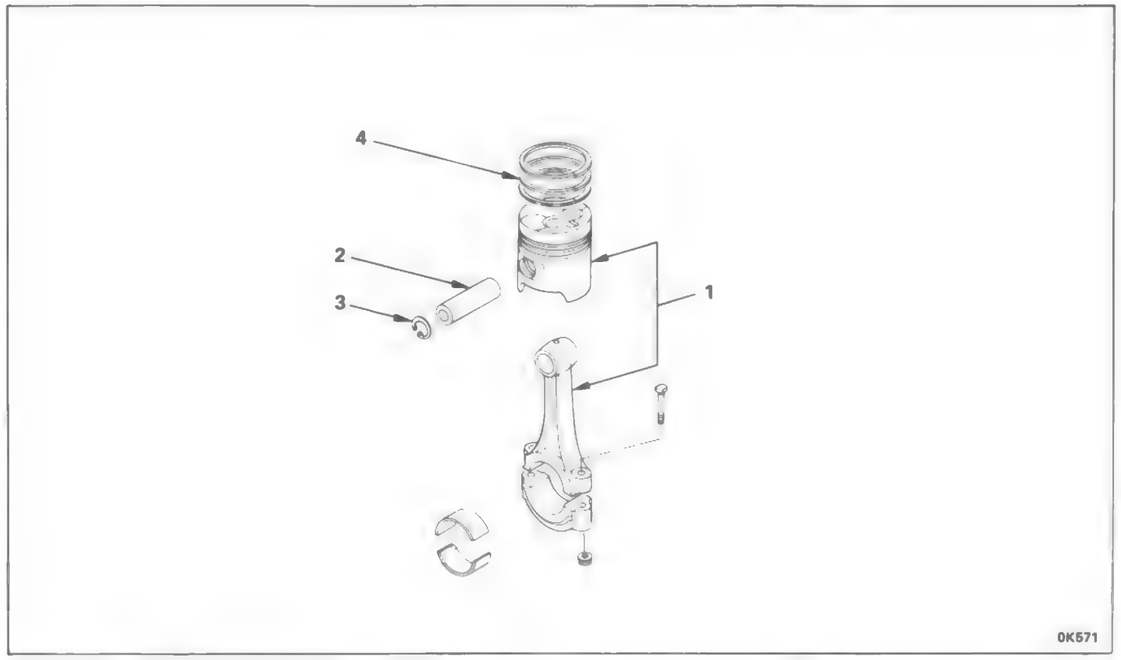




3. Spring seat and split key

Compressor : 9-8523-1423-0

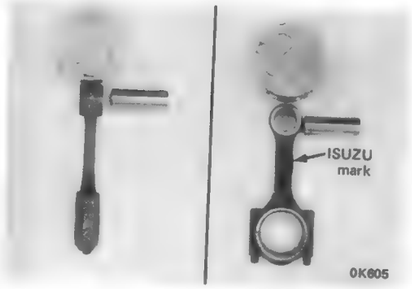
PISTON AND CONNECTING-ROD ASSEMBLY



Reassembly steps

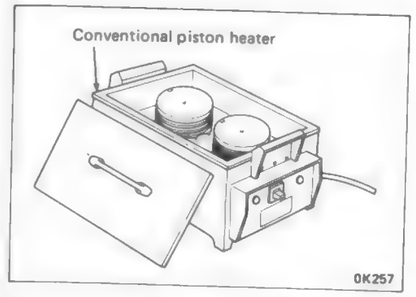
- ▲1. Piston and connecting-rod
- ▲2. Piston pin
- ▲3. Snap ring
- ▲4. Piston ring

Important operations



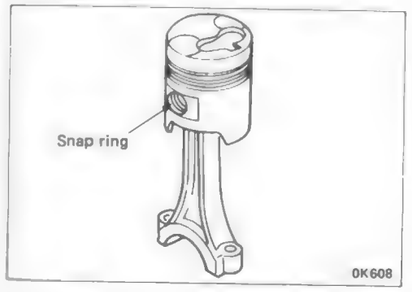
1. Piston and connecting-rod

Install the piston on the connecting-rod, so that combustion chamber on piston head is on the same side with the cylinder number mark side (side with bearing stopper) of the connecting-rod big-end.
Isuzu mark on the connecting-rod should be on the same side of the front mark on the piston head.



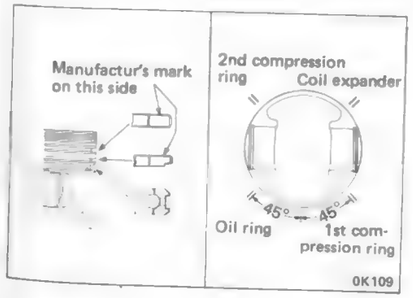
2. Piston pin

Install the piston pin after heating the piston to about 100°C.



3. Snap ring

Install the snap ring into the piston using snap ring pliers, then check to make certain the snap ring is fitted properly into the groove.

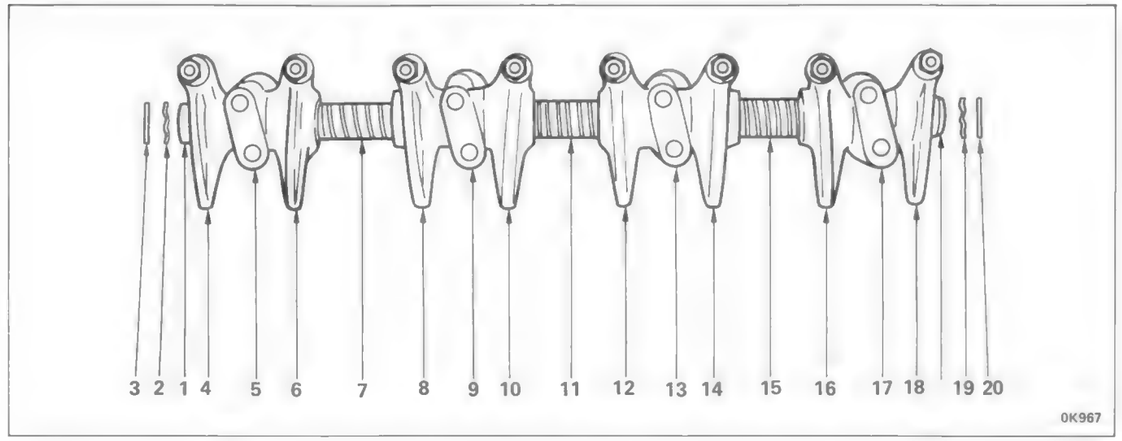


4. Piston ring

Installer : 1-85221-025-0

Install the 1st and 2nd compression rings with manufacturer's mark turned up. Oil ring can be installed on the piston with either side up.
Piston ring gaps should be positioned as shown in the figure.

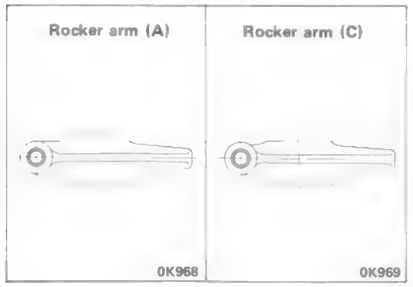
ROCKER ARM AND SHAFT ASSEMBLY



Reassembly steps

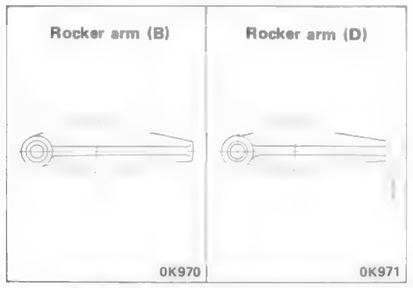
1. Rocker arm shaft
2. Waving washer
3. Snap ring
▲ 4. Rocker arm (A)
5. Rocker arm shaft bracket
▲ 6. Rocker arm (D)
7. Spring
▲ 8. Rocker arm (C)
9. Rocker arm shaft bracket
▲ 10. Rocker arm (D)
11. Spring
▲ 12. Rocker arm (C)
13. Rocker arm shaft bracket
▲ 14. Rocker arm (D)
15. Spring
▲ 16. Rocker arm (C)
17. Rocker arm shaft bracket
▲ 18. Rocker arm (B)
19. Waving washer
20. Snap ring

Important operations



4. Rocker arm (A)
8. 12. 16. Rocker arm (C)

Difference between rocker arm A and C.

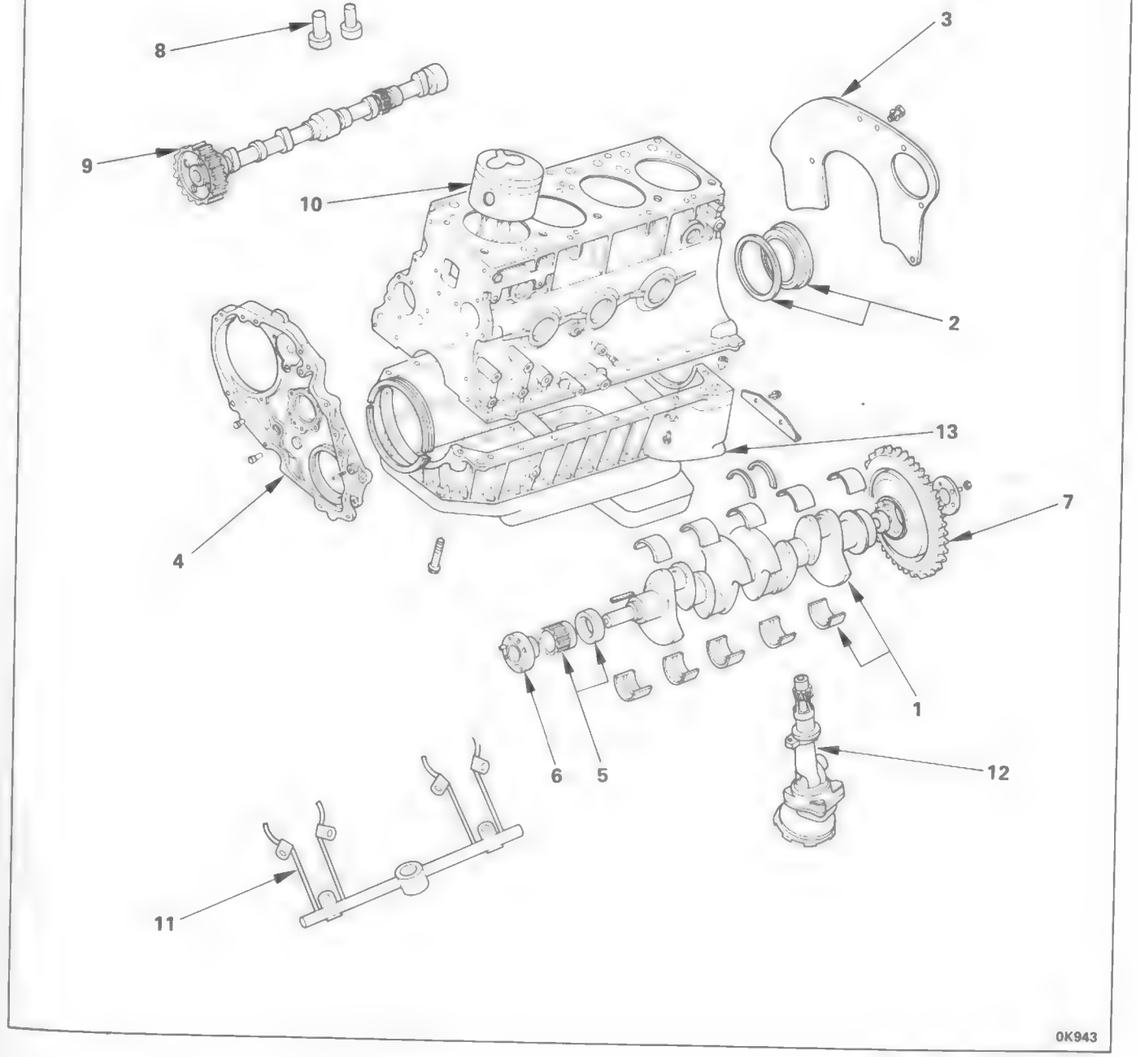


18. Rocker arm (B)
6. 10. 14. Rocker arm (D)

Difference between rocker arm B and D.

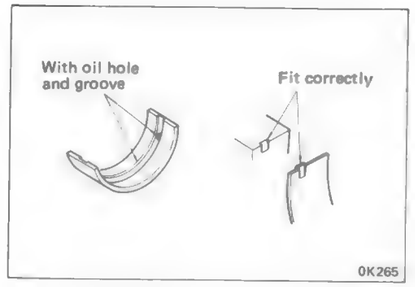
INTERNAL PARTS I

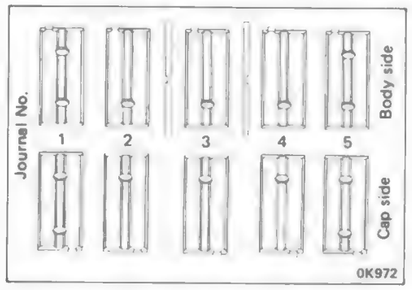
MAJOR COMPONENT

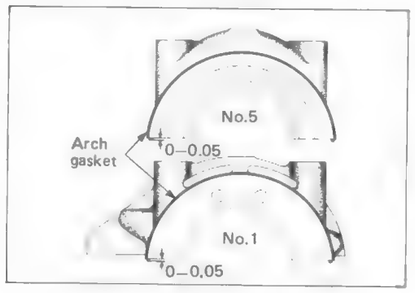


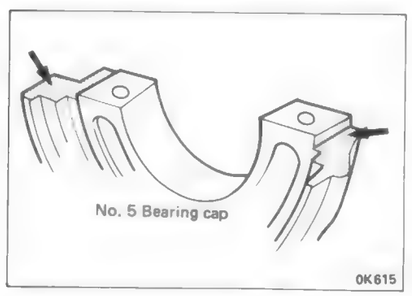
Reassembly steps

▲ 1. Crankshaft and bearing
▲ 2. Rear oil seal
3. Rear plate
4. Timing pulley housing
▲ 5. Crankshaft timing pulley
▲ 6. Crankshaft pulley center (C190GB only)
▲ 7. Flywheel
8. Tappet
9. Camshaft assembly
▲ 10. Piston and connecting-rod
▲ 11. Oiling jet
12. Oil pump
▲ 13. Crankcase and oil pan









Important operation

1. Crankshaft and bearing

The following points should be noted to avoid interchanging the crankshaft for C190 model engine with that from C240 model.

(mm)

Journal diameter	C190 model	60
	C240 model	70

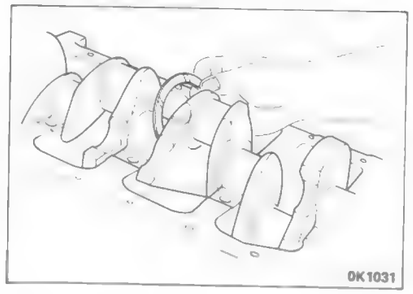
Install the crankshaft after applying engine oil to the face of the bearing in contact with the crankshaft.

The bearings should be installed correctly in their respective position. Install the thrust bearing with the oil grooved side turned outward.

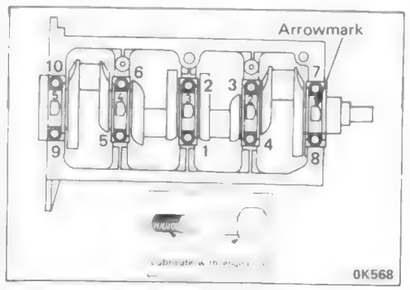
Installation of bearing cap arch gaskets
Install the arch gasket on the No. 1 and No. 5 bearing caps.

Amount of projection of gasket (mm)	0 — 0.05

Apply a coat of silicone gasket evenly to the joining faces of the No. 5 bearing cap and cylinder body.
The No. 1 and No. 5 bearing caps should be installed flush with the face of the cylinder body.



Install front and rear side thrust bearings with the oil groove turned to the timing gear and flywheel, respectively.

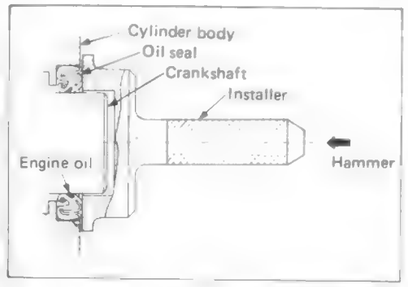


Tighten crankshaft bearing cap bolts in numerical order.

Torque (kg-m)		16 — 18

(mm)

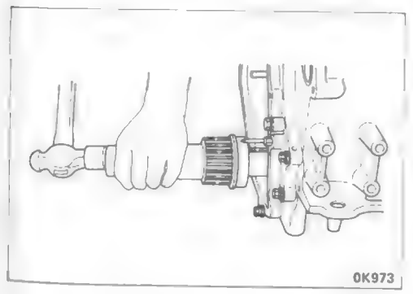
Bolt length	C190GB, C190	89
	C240	97



2. Rear oil seal

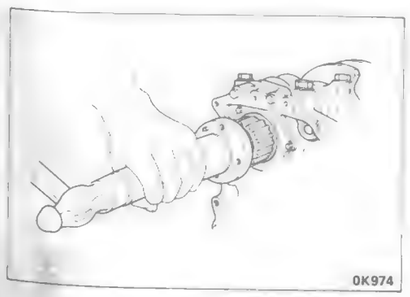
Apply engine oil to the lipped portion of the rear oil seal, then install it in position using installer.

Installer : 9-8522-1279-0



5. Crankshaft timing pulley (C190GB only)

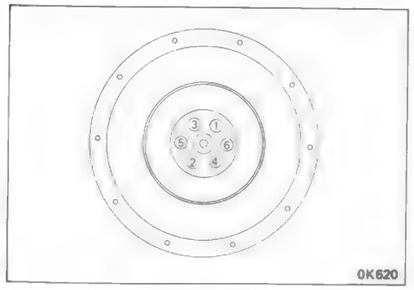
Installer : 9-8522-0021-0



6. Crankshaft pulley center (C190GB only)

Installer : 9-8522-0021-0

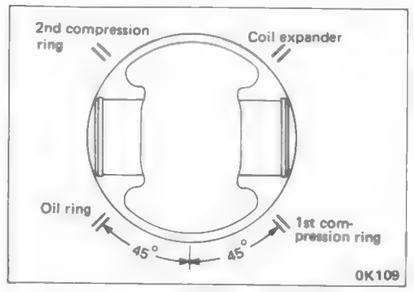
Torque	(kg-m)	19.0



7. Flywheel

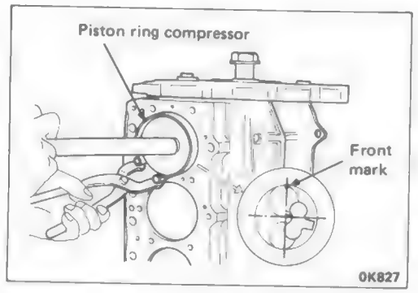
Tighten the bolts in the numerical order as the illustration.

Torque (kg-m)	12.0



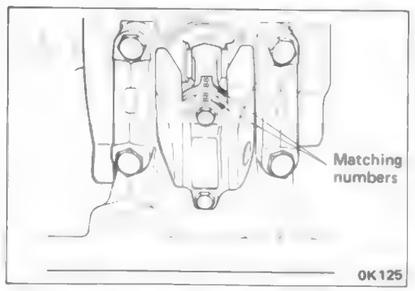
10. Piston and connecting-rod

Lightly oil the piston rings fitted to the piston, then position piston ring gaps as illustrated in the drawing.



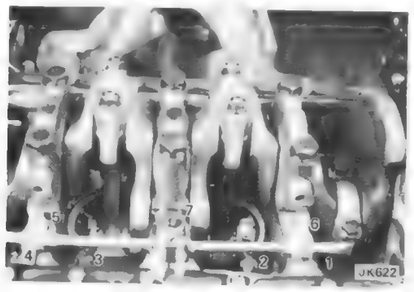
Piston ring compressor : 9-8522-1255-0

Install the piston and connecting-rod with mark turned to the front of engine.



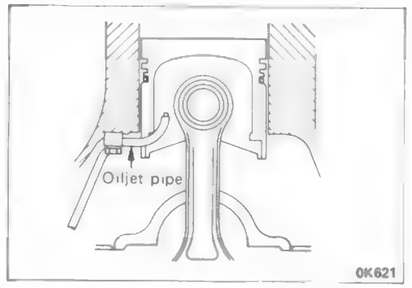
Install the connecting-rod bearing caps by matching numbers.

Torque (kg-m)	8.0 — 9.0

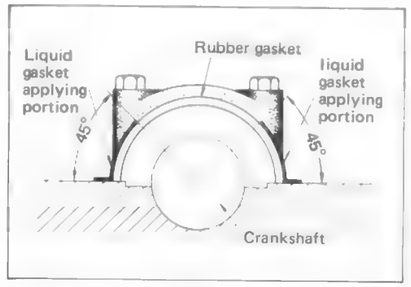


11. Oiling jet

Tighten oiling jet pipe fixing bolts in numerical sequence.



Turn the crankshaft and check to make certain oil jet pipe is apart from the piston.



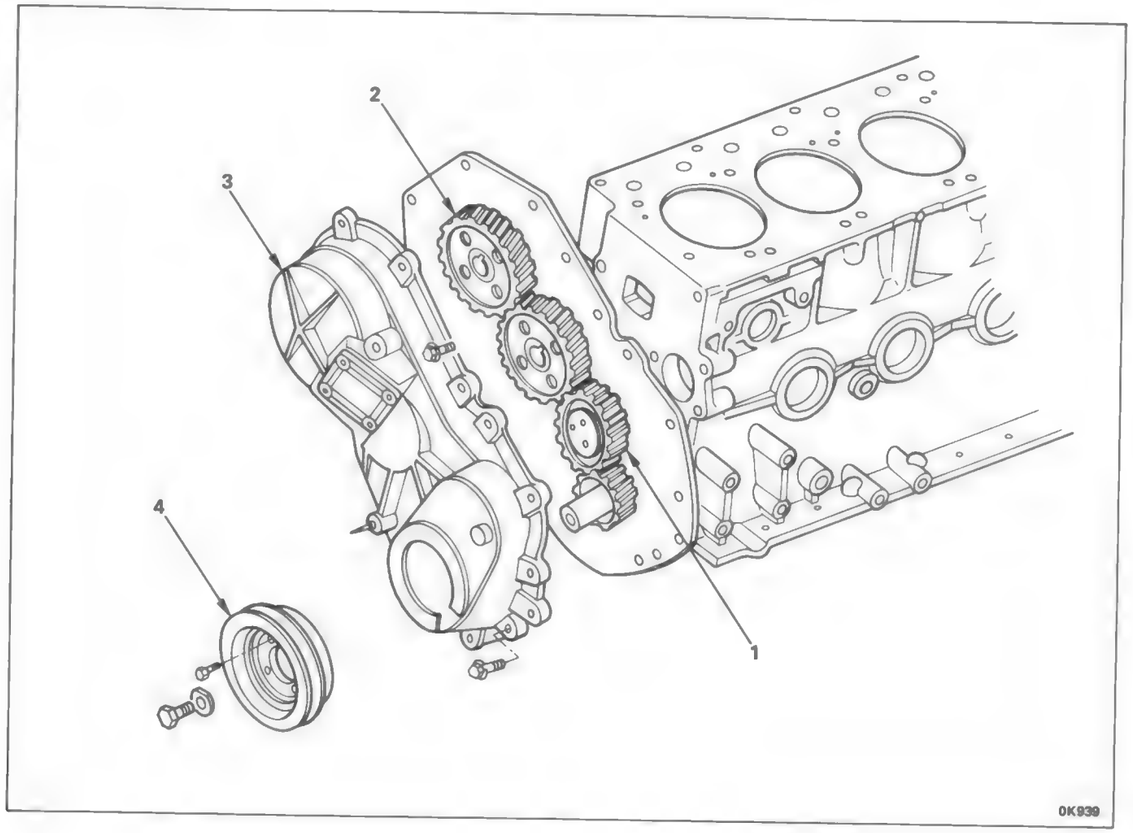
13. Crankcase

Apply liquid gasket to the arch gasket fitting face of the No. 1 and No. 5 bearing caps.

INTERNAL PARTS (Timing gear train)

MAJOR COMPONENTS

Gear drive type

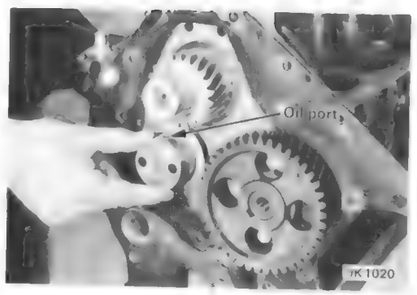


0K939

Reassembly steps

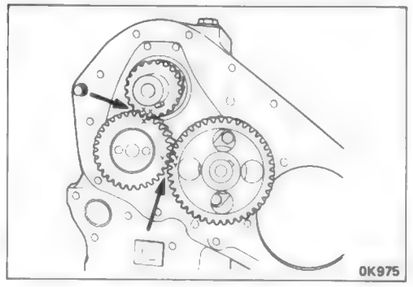
- ▲1. Idler gear assembly
- ▲2. Injection pump gear
- ▲3. Timing case cover
- ▲4. Damper pulley

Important operations

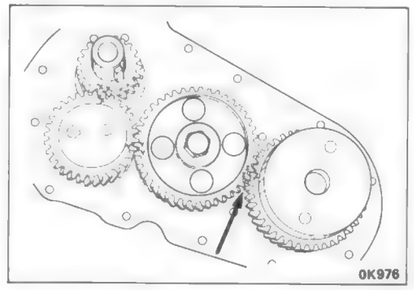


1. Idler gear

Install the idler gear, so that the oil port in the idler gear shaft is turned to the crankshaft gear side and bolt holes are aligned.

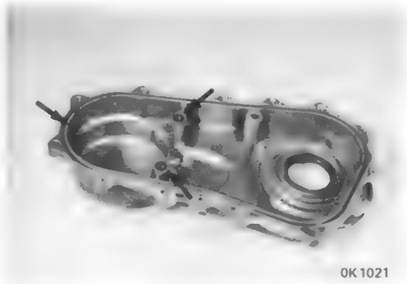

0K975

Align the marks on the camshaft gear, idler gear and crankshaft gear.


0K976

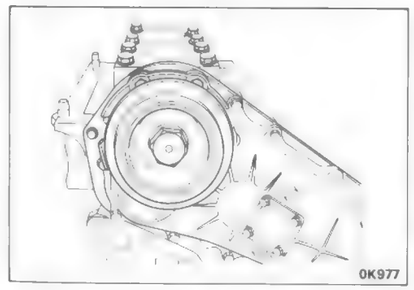
2. Injection pump gear

Install the injection pump gear together with injection pump by aligning the mark with that on the camshaft.


0K1021

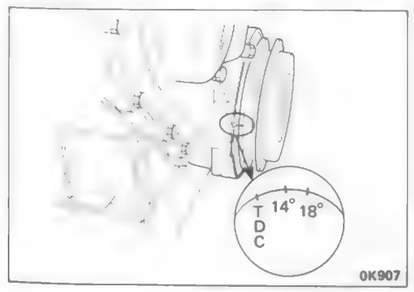
3. Timing case cover

Check to make certain the O-ring is fitted properly into ring groove in the timing gear case cover.


0K977

4. Pulley

Torque	(kg-m)	19.0

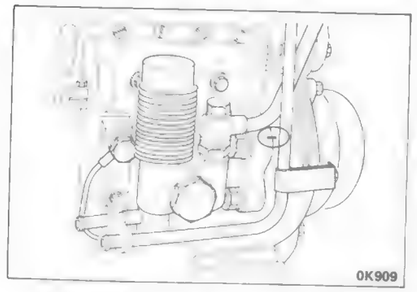


0K907

Injection timing adjustment

Bring the piston in No. 1 cylinder to the injection timing before T.D.C. on compression stroke, so that TDC line on the pulley is aligned with the pointer.

Timing	C190	18°
	C240	14°

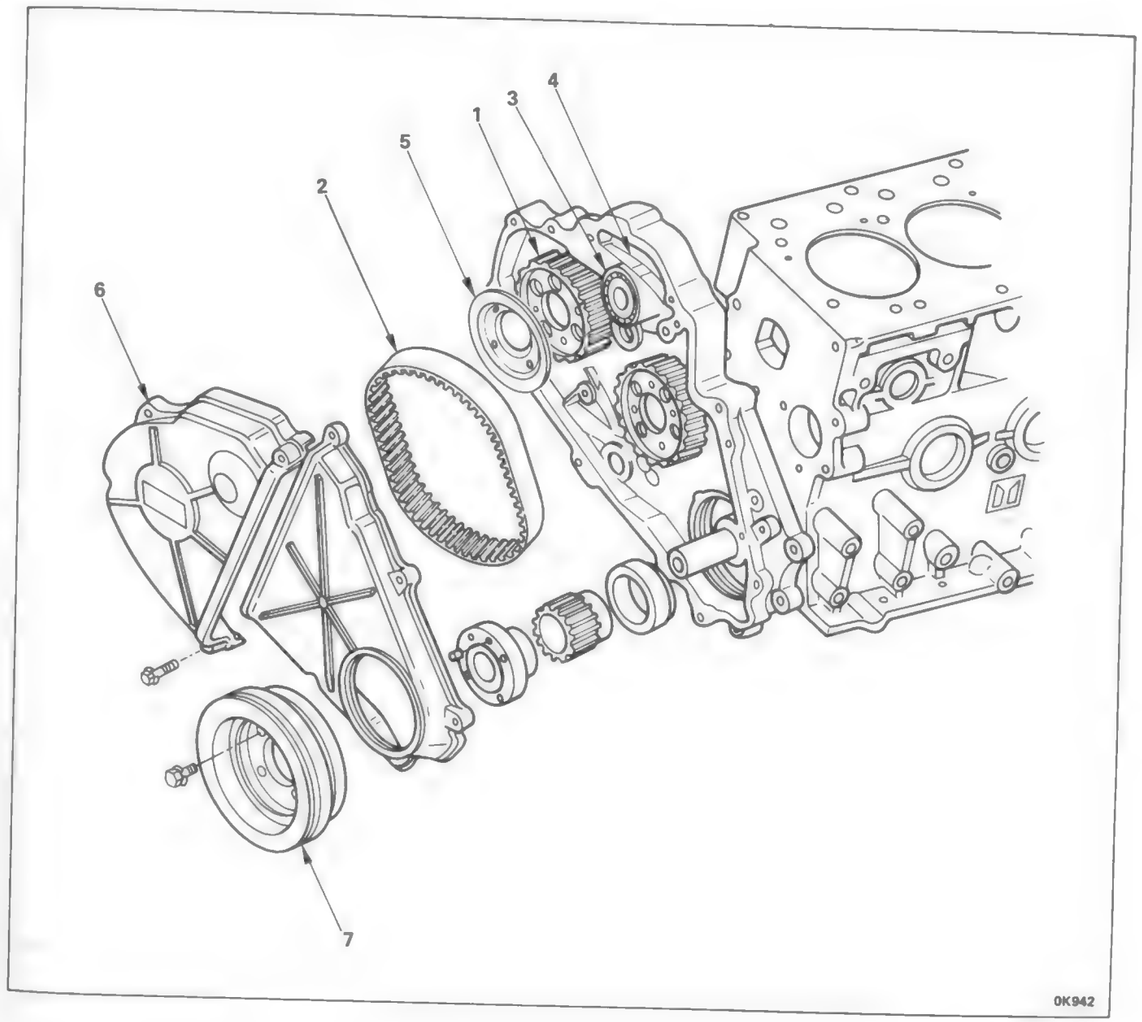


Bring the mark on the injection pump housing with the mark on the injection pump bracket.

INTERNAL PARTS (Timing gear train)

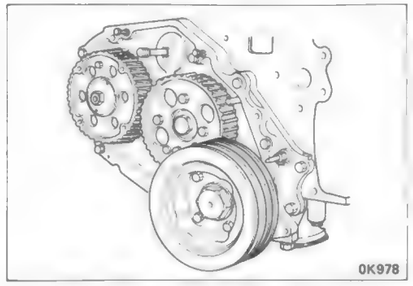
MAJOR COMPONENTS

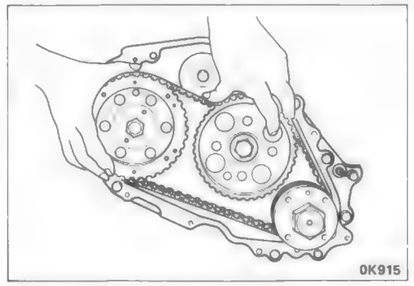
Belt drive type

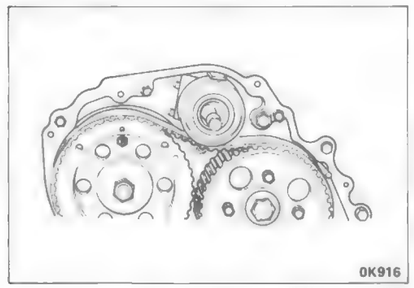


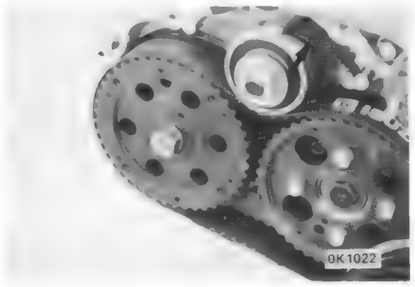
Reassembly steps

1. Injection pump gear
▲ 2. Timing belt
▲ 3. Tension bearing and center
▲ 4. Tension spring
▲ 5. Frange
6. Pulley housing cover
7. Pulley


0K978


0K915


0K916


0K1022

Important operations

2. Timing belt

Install the damper pulley and align the TDC mark on the pulley with the pointer and mark " ▲ " on the injection pump pulley with the mark " ▲ " on the camshaft timing pulley, then secure the injection pump timing pulley and camshaft timing pulley with bolts.

Remove the damper pulley and install the drive belt on the pulleys in sequence of the camshaft timing pulley, camshaft timing pulley and injection pump timing pulley. Collect slackness of the drive belt on the tension bearing.

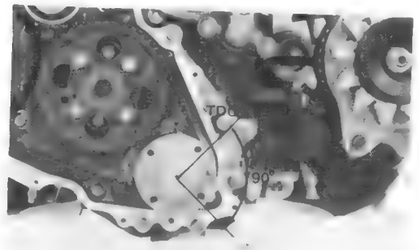
3. Tension bearing and center

Install the tension bearing and center by aligning the end of the tension center with the pins on the pulley housing, then finger tighten the tension bearing nut.

4. Tension spring

Install the tension spring properly.
Remove the pulley fixing bolts and set the tension bearing temporarily.

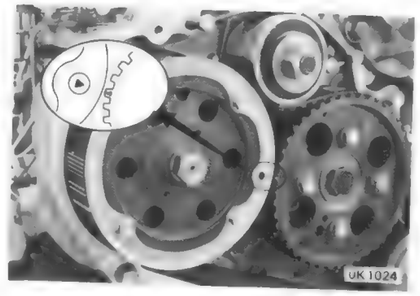
Torque	(kg-m)	3 — 5



0K1023

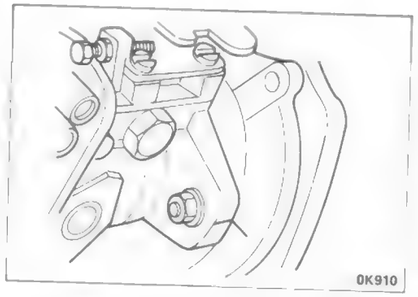
Turn the crankshaft two turns in normal direction of rotation, then turn it further 90 degrees beyond the top dead center.
Loosen the tension spring to let the spring take up slackness of the drive belt.
Tighten the bearing nut to specification.

Torque	(kg-m)	11 — 13


0K1024

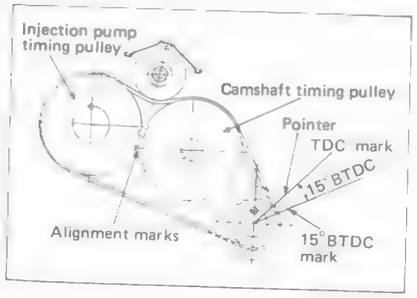
5. Flange

Install the flange by aligning the hole in the outer circumference of the flange with the timing mark " ▲ " on the injection pump.
Turn the crankshaft two turns and check that the timing marks are in alignment.

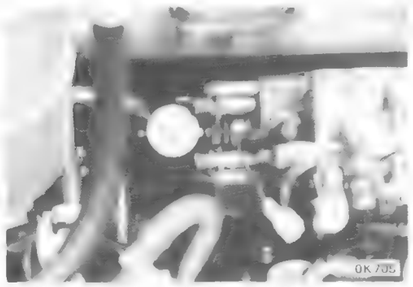

0K910

Timing adjustment

Check that notched line on the injection pump flange is in alignment with notched line on the front plate.



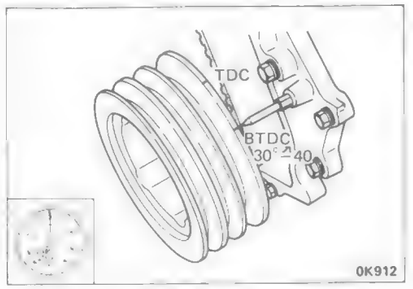
Bring the piston in No. 1 cylinder to top dead center on compression stroke by turning the crankshaft as necessary. With the front upper cover removed, check that timing belt is properly tensioned and that timing marks are aligned.



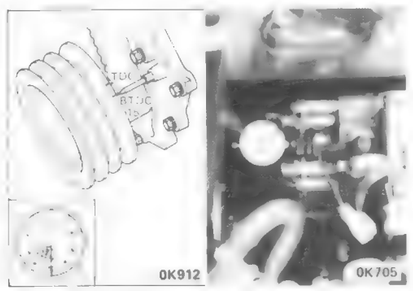
Disconnect the injection pipe from the injection pump and remove the distributor head screw, then install measuring device.

The dial indicator should be installed with the prbe depressed inward by approximately 2 mm.

Measuring device



Bring the piston in No. 1 cylinder to a point 30° — 40° before top dead center by turning the crankshaft, then calibrate the dial indicator to zero.

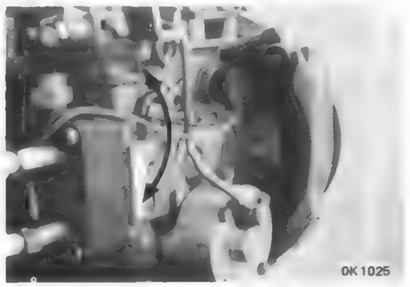


Turn the crankshaft until the line 15° on damper pulley is brought into alignment with the pointer, then take reading of the dial indicator.

Timing	15°

Standard reading (mm)	0.47 — 0.53

Turn the crankshaft in normal direction of rotation.

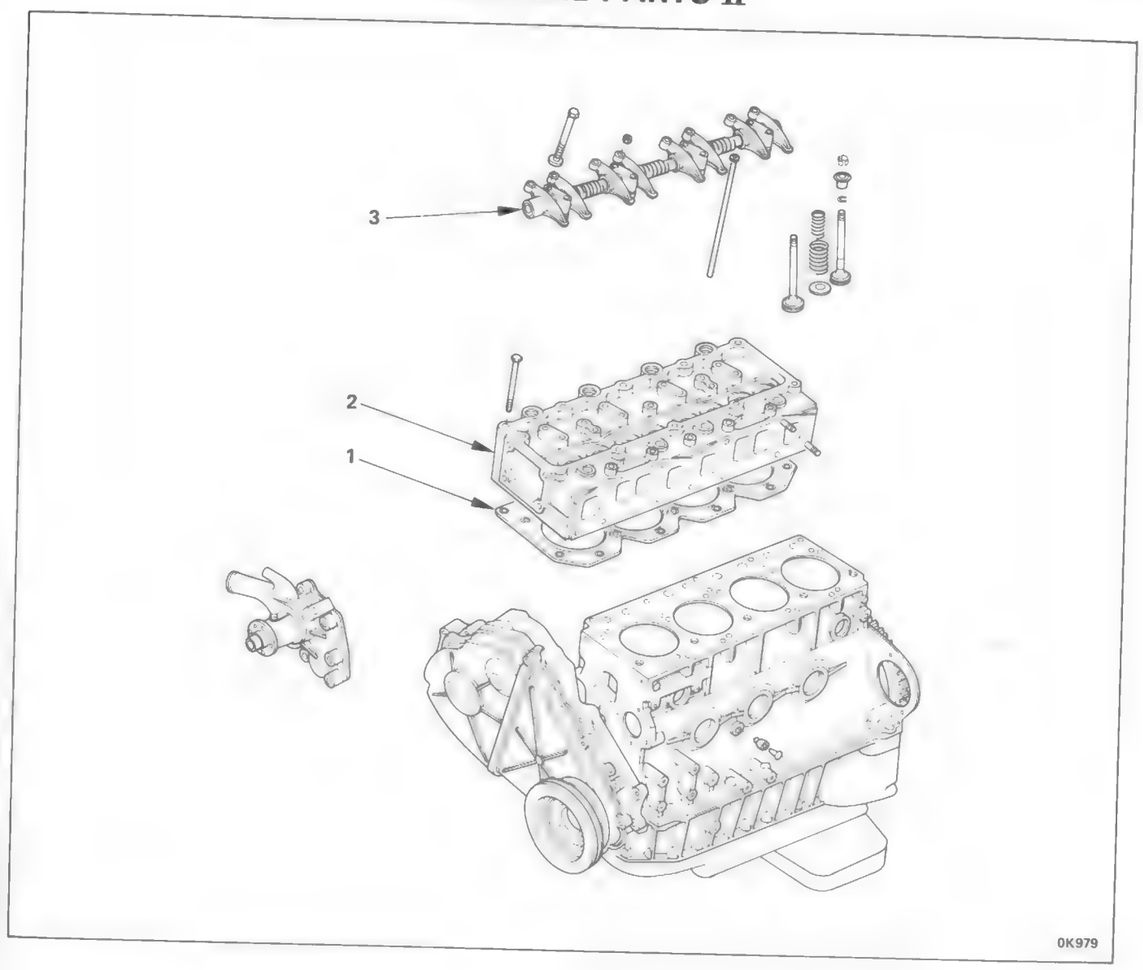


If the injection timing deviates from the specified range, loosen pump fixing nuts and bracket bolts, then make an adjustment by varying injection pump setting angle.

When larger than standard value:
Turn the injection pump toward the engine so that the dial gauge reads the standard value.

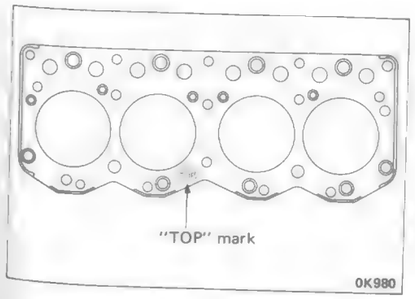
When smaller than standard value:
Turn the injection pump away from the engine so that the dial gauge reads the standard value.

INTERNAL PARTS II



Reassembly steps

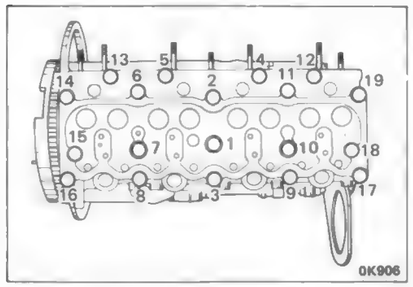
- ▲1. Cylinder head gasket
- ▲2. Cylinder head
- ▲3. Rocker armshaft assembly
- 4. Water pump



Important operations

1. Cylinder head gasket

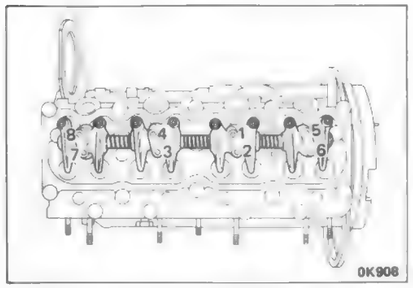
Install gasket with "TOP" mark side up on the cylinder body.



2. Cylinder head

Tighten cylinder head bolts in numerical sequence.

	1st step	2nd step
New bolt	6.5	8.0
Reused bolt	6.5	9.0



3. Rocker armshaft assembly

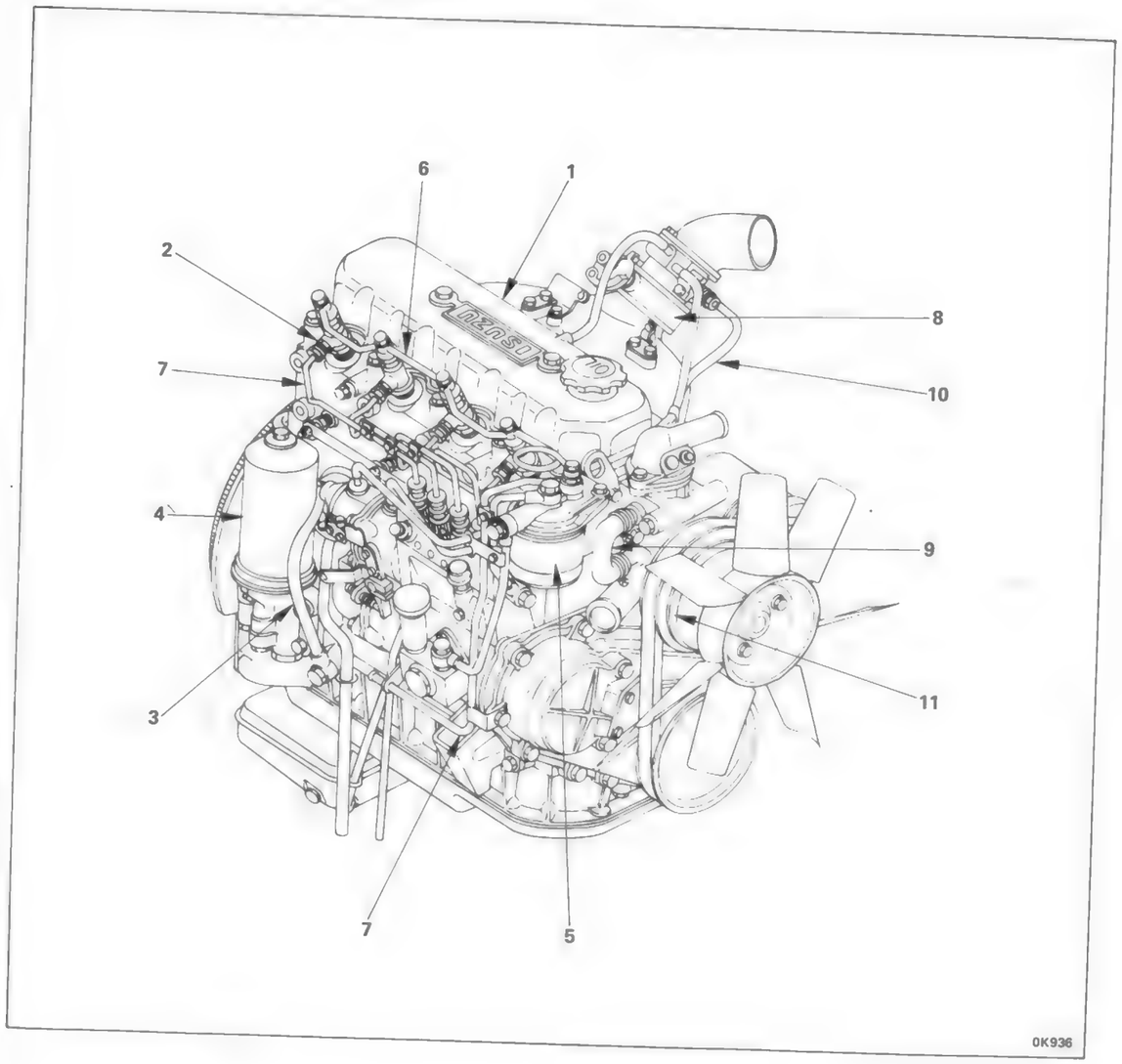
Tighten rocker armshaft bracket bolts in numerical order.

Rocker arm bracket torque (kg-m)	1.3 — 2.3

Adjust the valve clearances referring to page 1-13.

EXTERNAL PARTS (Right hand side)

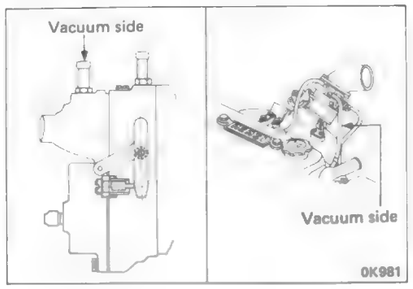
This illustration is based on the C240 model



Reassembly steps

1. Cylinder head cover
2. Injection nozzle
3. Oil pipe : oil gallery to vacuum pump
4. Oil filter
5. Fuel filter
6. Leak off pipe
7. Fuel pipe
8. Intake shutter and throttle valve
9. Water hose
▲10. Vacuum hose
11. Fan pulley

Important operation

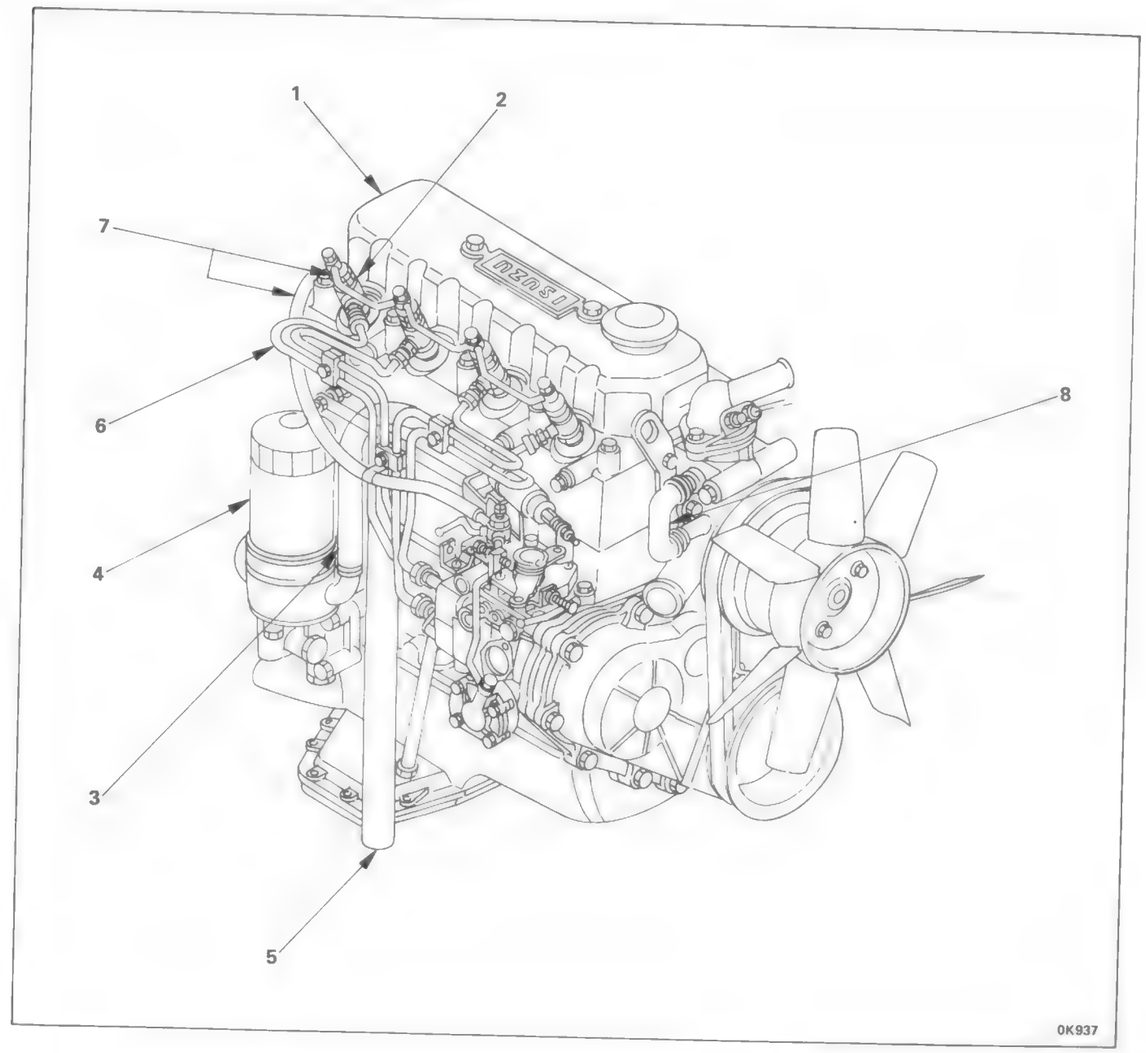


10. Vacuum hose

Connect red colored vinyl hose to the hose joint on the vacuum side.

EXTERNAL PARTS (Right hand side)

This illustration is based on the C190GB model

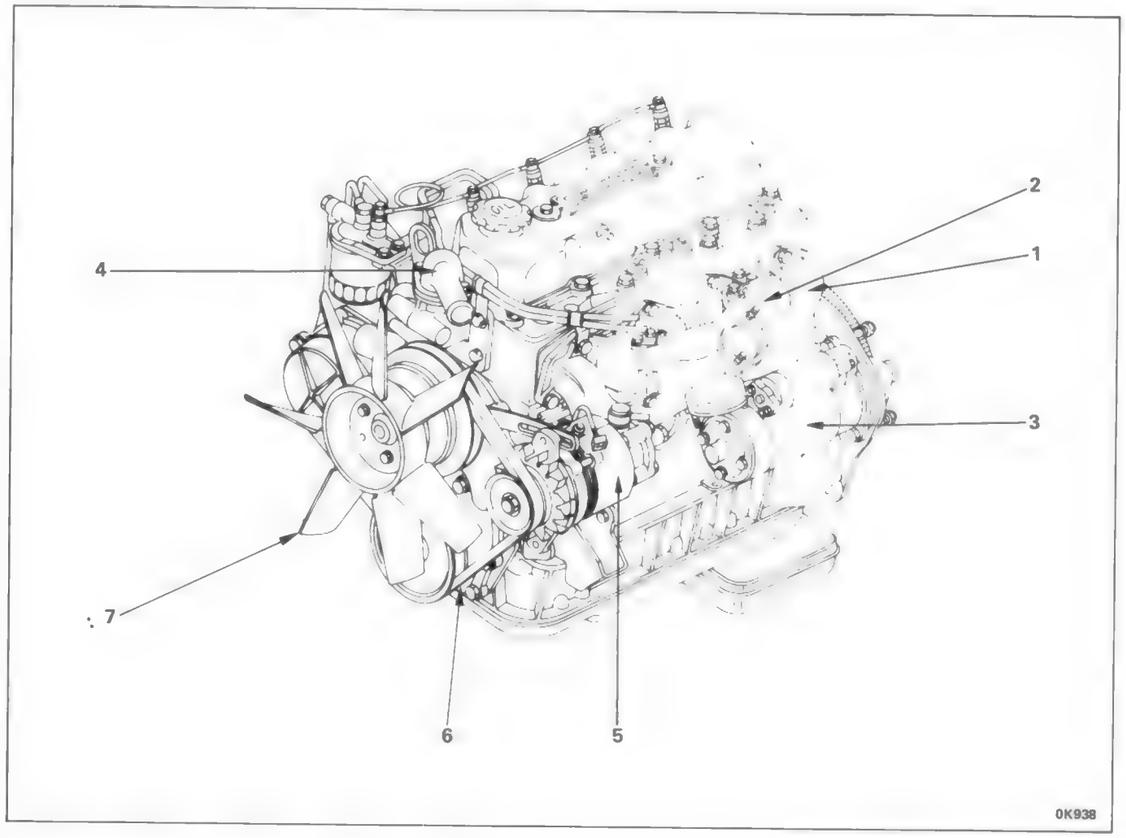


Reassembly steps

1. Cylinder head cover
2. Injection nozzle
3. Water hose
4. Oil filter assembly
5. Air breather hose
6. Injection pipe
7. Leak off pipe
8. Water hose

EXTERNAL PARTS (Left hand side)

This illustration is based on the C190 and C240 models.



Reassembly steps

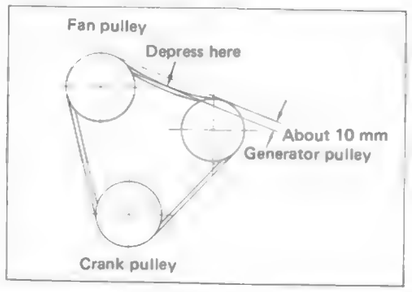
1. Exhaust manifold
2. Intake manifold
3. Starter motor
4. Thermostat housing
5. Generator assembly
▲6. Fan belt
7. Cooling fan and spacer

Important operation

6. Fan belt

Specified belt deflection

Fan belt	(mm)	10



SECTION 3

LUBRICATING SYSTEM

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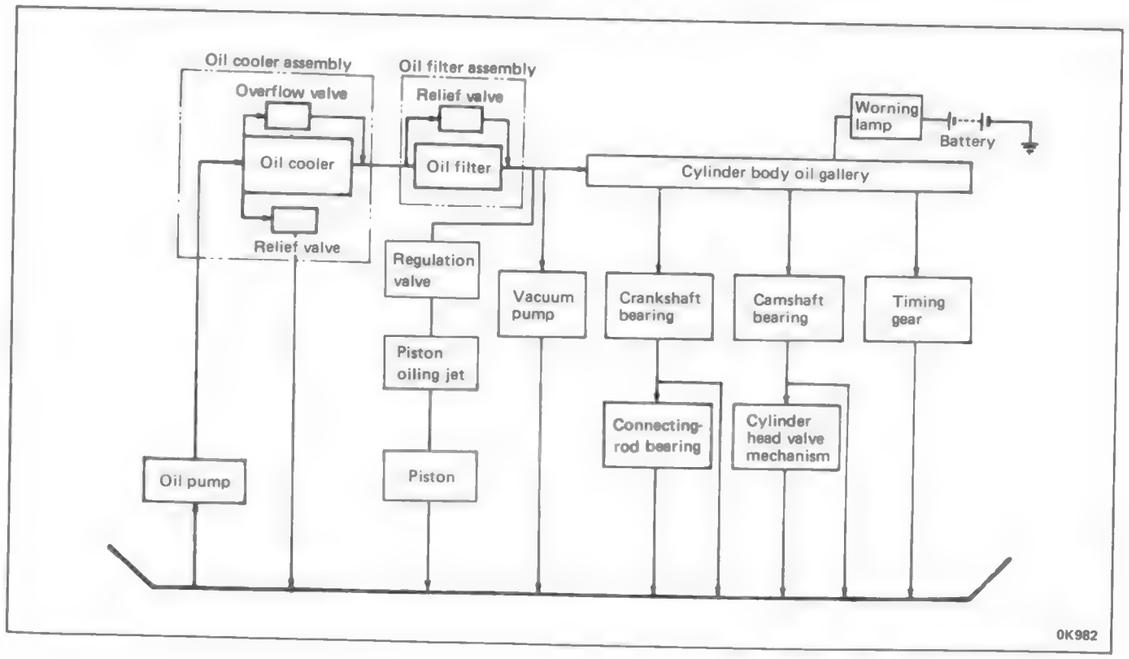
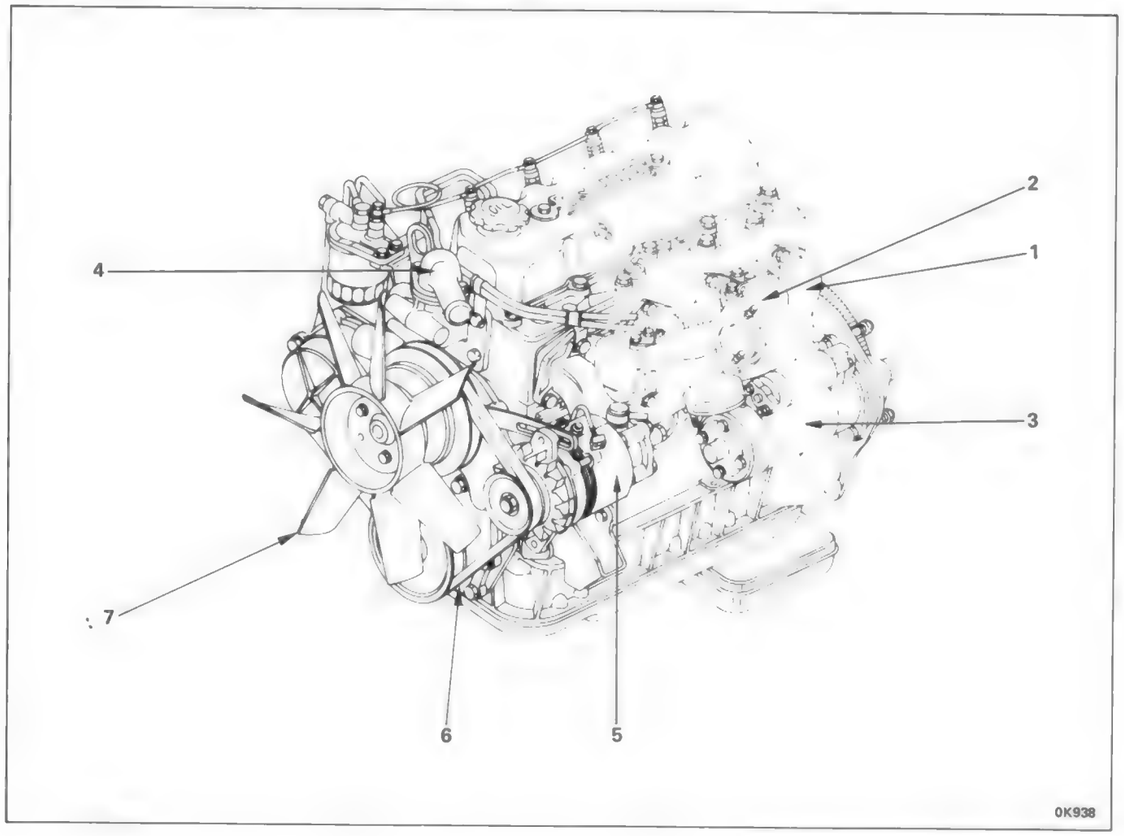
With oil cooler type	3– 8
Oil cooler	3–10
Oil jet pipe and relief valve	3–10

GENERAL DESCRIPTION



EXTERNAL PARTS (Left hand side)

This illustration is based on the C190 and C240 models.



Reassembly steps

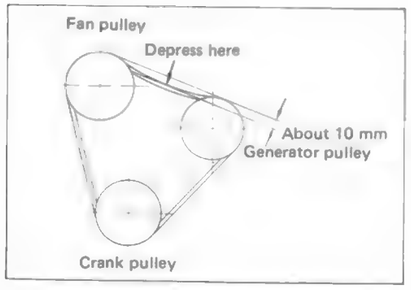
1. Exhaust manifold
2. Intake manifold
3. Starter motor
4. Thermostat housing
5. Generator assembly
▲6. Fan belt
7. Cooling fan and spacer

Important operation

6. Fan belt

Specified belt deflection

Fan belt	(mm)	10



SECTION 3

LUBRICATING SYSTEM

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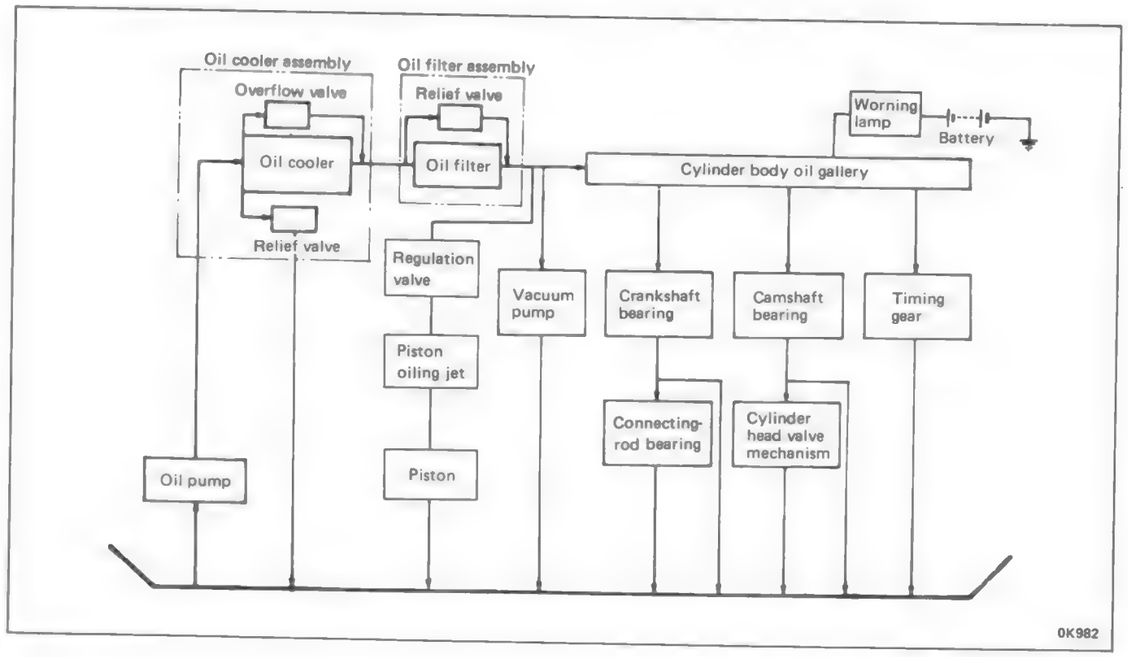
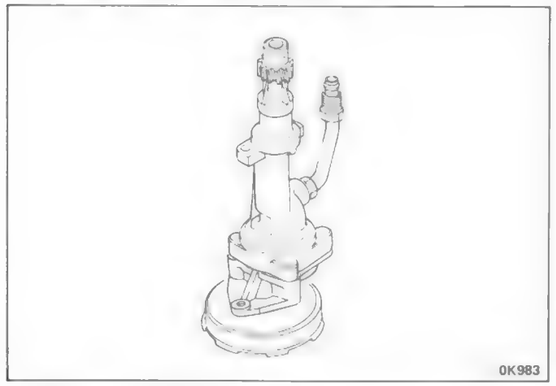
GENERAL DESCRIPTION

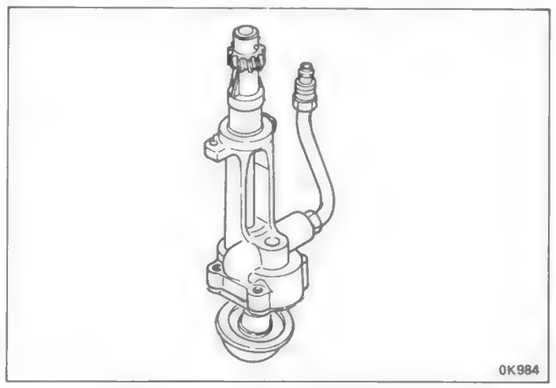


OIL PUMP

This illustration is based on rotor type

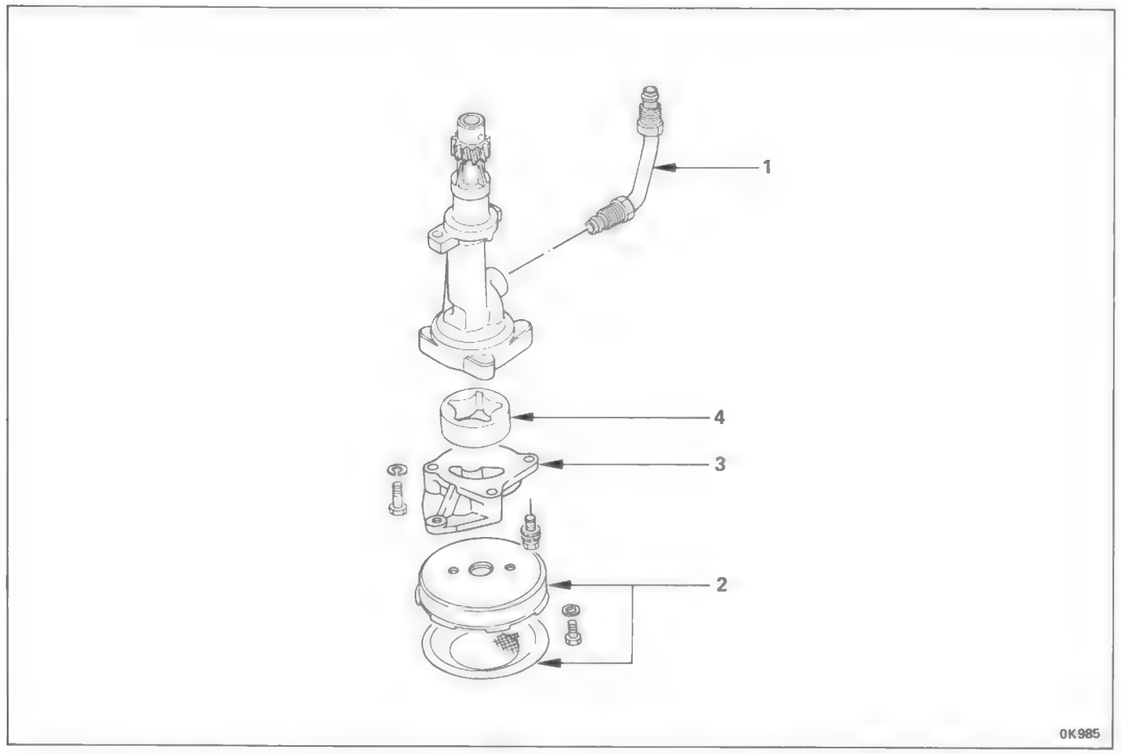


This illustration is based on gear type



DISASSEMBLY

Rotor type

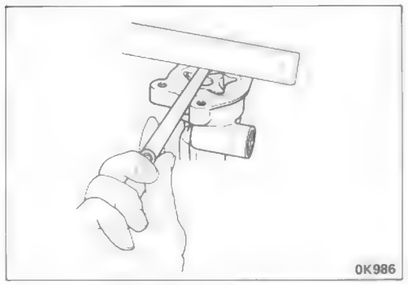


Disassembly steps

1. Oil pipe
2. Strainer
3. Pump cover
4. Vane

INSPECTION AND REPAIR

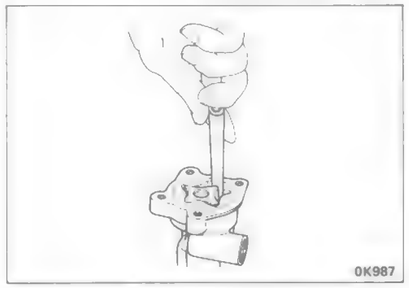
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Clearance between vane, and body.

(mm)

Standard	Limit
0.02 — 0.07	0.15



Clearance between rotor and vane.

(mm)

Standard	Limit
0.02 — 0.13	0.15

Clearance between vane and pump body.

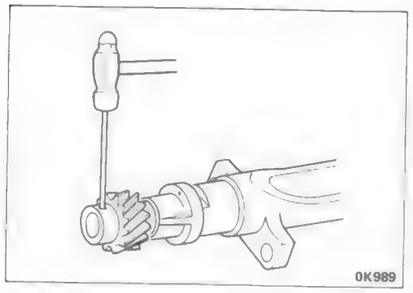
Standard	(mm)	0.2 — 0.27

Clearance between rotor shaft and pump body.

(mm)

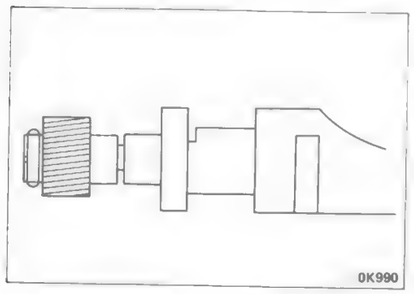
Standard	Limit
0.04	0.2

Pinion replacement



Removal

File off caulked end of the pinion stopper pin, then drive out the pin toward opposite side.

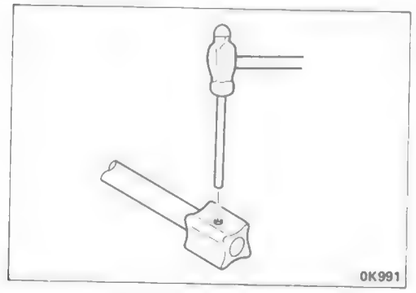


It is necessary to drill a hole in one side of the pinion for service as it does not have a hole on both sides.

Installation

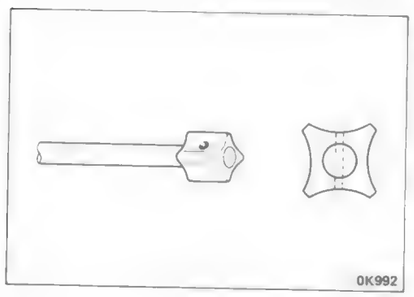
Install a new stopper pin and caulk end of pin after installation.

Rotor replacement



Removal

Drive out the pin from one side.



Installation

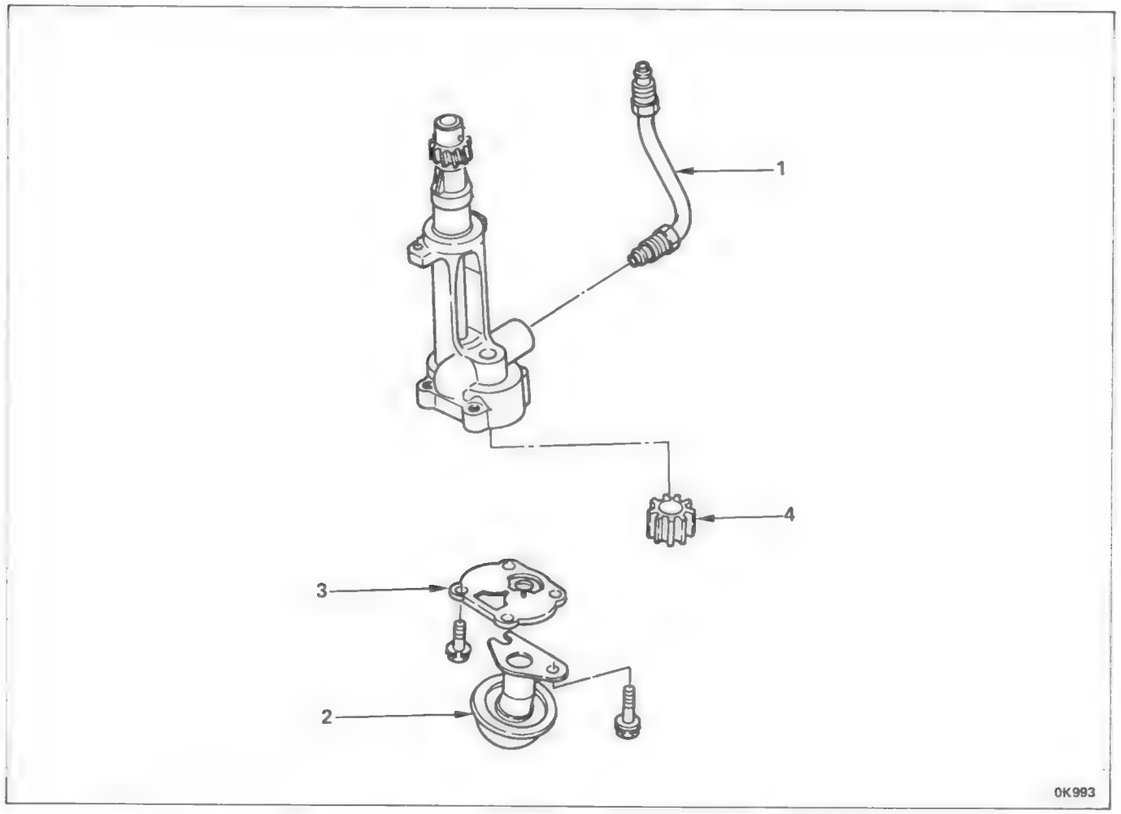
When the pin is installed, check to make certain end of the pin is not projected from the end of rotor.

REASSEMBLY

To assemble, follow the disassembly procedure in reverse order.

DISASSEMBLY

Gear type

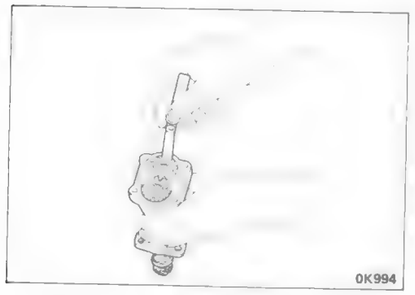


Disassembly steps

1. Oil pipe
2. Strainer
3. Cover
4. Driven gear

INSPECTION AND REPAIR

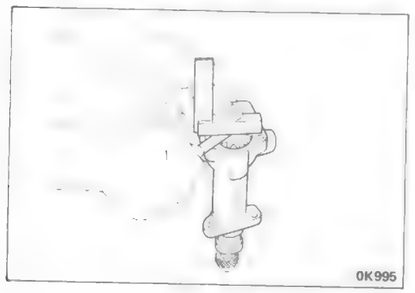
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Clearance between gear teeth and body inner wall.

(mm)

Standard	Limit
0.12 — 0.13	0.15



Clearance between body and gear.

(mm)

Standard	Limit
0.04 — 0.09	0.10

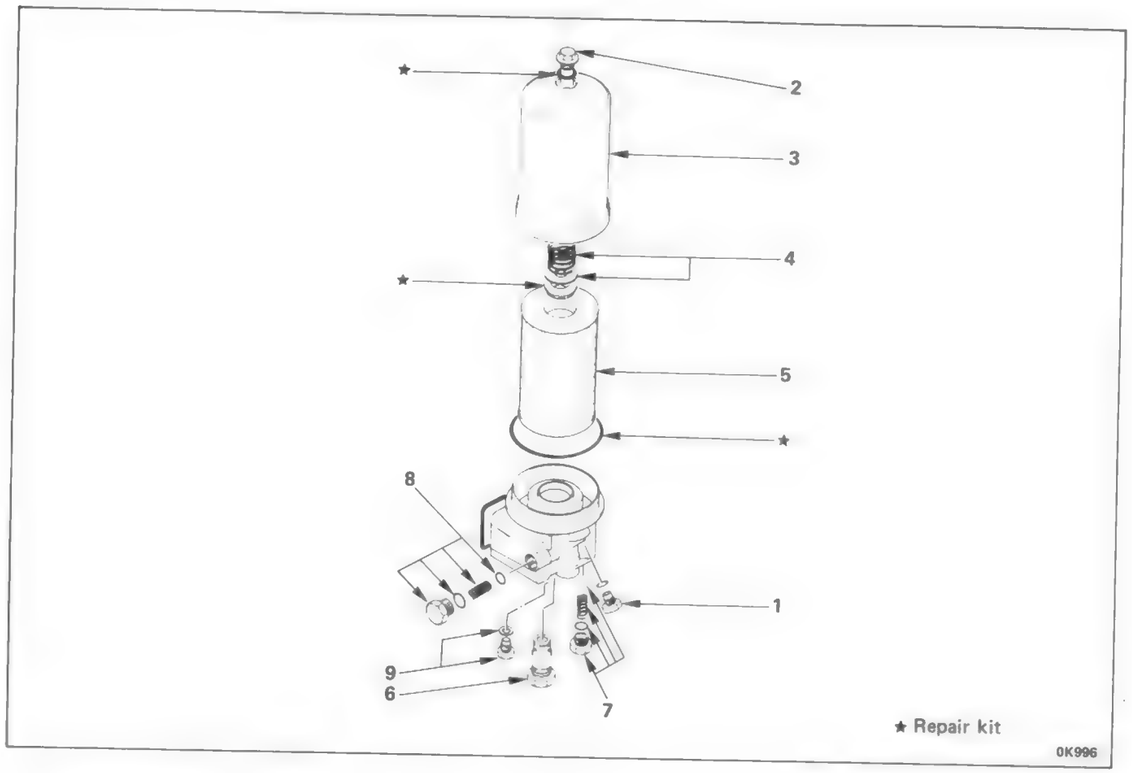
REASSEMBLY

To assemble, follow the disassembly procedure in reverse order.

OIL FILTER

DISASSEMBLY

C240 model



Disassembly steps

1. Drain plug
2. Center bolt
3. Cover
4. Spring, seat and gasket
5. Element
6. Relief valve assembly
7. Overflow valve assembly
8. Oil cooler relief valve (Model with oil cooler)
9. Plug and O-ring (Model without oil cooler)

INSPECTION AND REPAIR

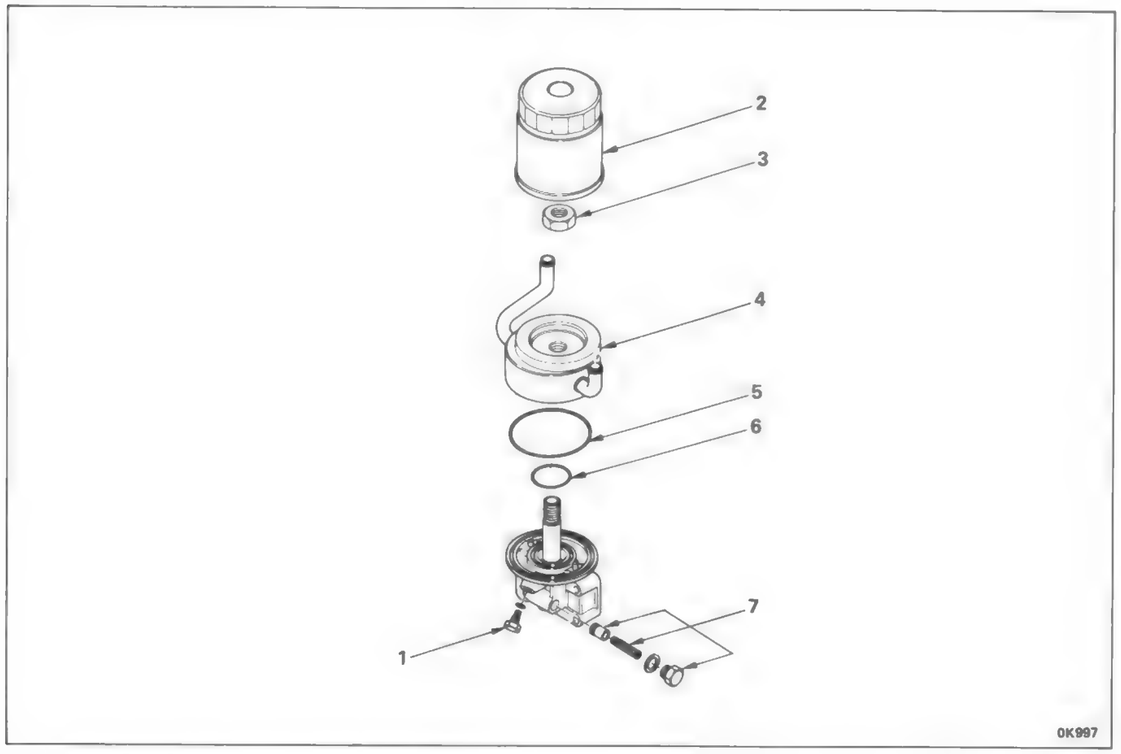
Make necessary correction or parts replacement if damage or any other abnormal conditions are found through inspection.

REASSEMBLY

To assemble, follow the disassembly procedure in reverse order.

WITH OIL COOLER TYPE

DISASSEMBLY



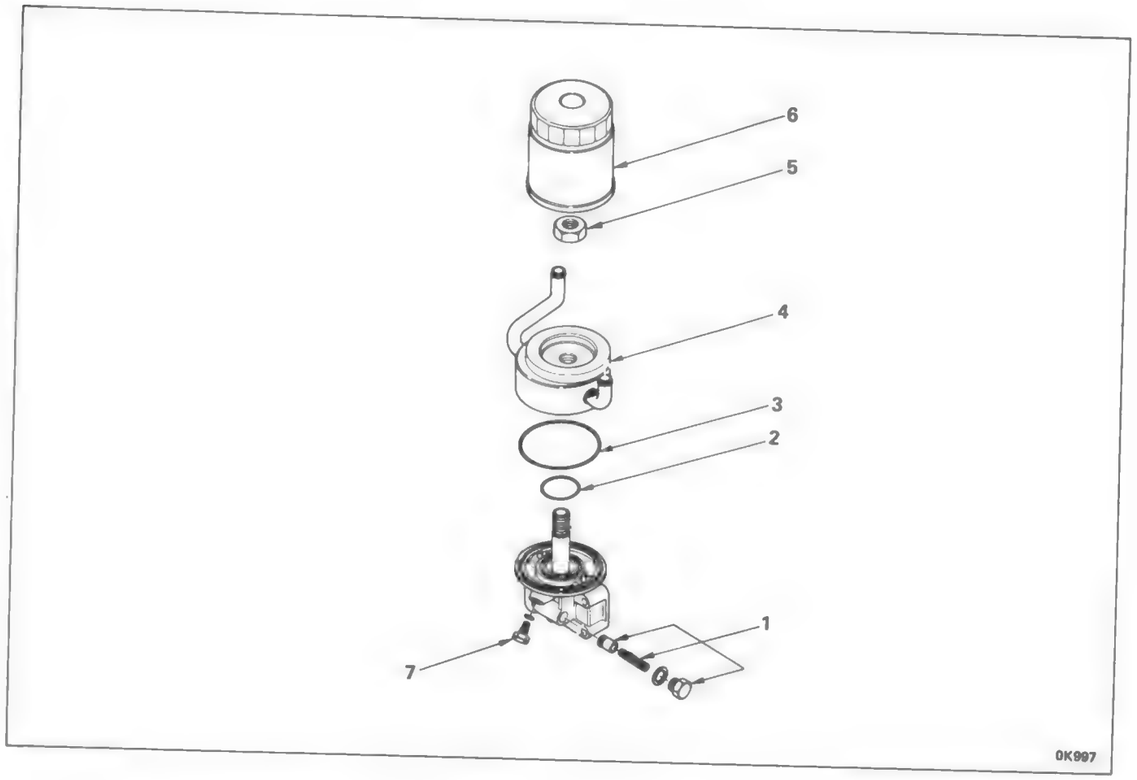
Disassembly

1. Drain plug
2. Cartridge oil filter
3. Nut
4. Oil cooler
5. O-ring
6. O-ring
7. Oil cooler relief valve assembly

INSPECTION AND REPAIR

Make necessary correction or parts replacement if damage or any other abnormal conditions are found through inspection.

REASSEMBLY



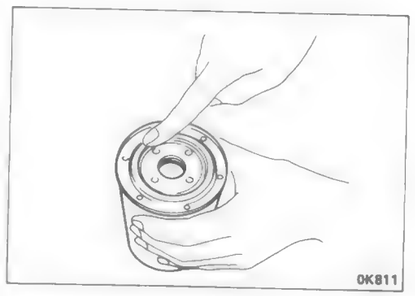
Reassembly steps

1. Oil cooler relief valve assembly
2. O-ring
3. O-ring
4. Oil cooler
- ▲ 5. Nut
- ▲ 6. Cartridge oil filter
7. Drain plug

Important operations

5. Nut

Torque	(kg-m)	2.5 — 3.5

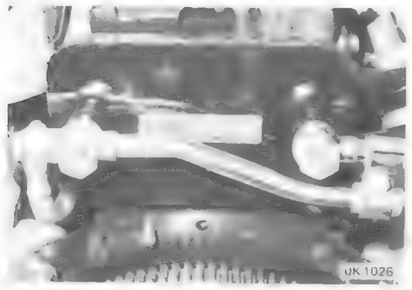


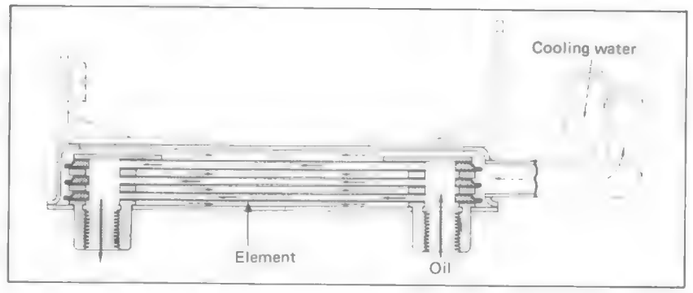
6. Cartridge oil filter

Apply engine oil to O-ring.
Turn in filter until sealing face is brought into connect with the O-ring. Further tighten 2/3 of a turn.

OIL COOLER

C240 type





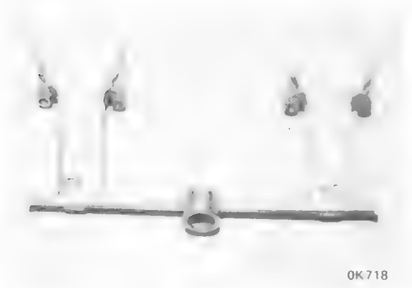
INSPECTION AND REPAIR

Make necessary correction or parts replacement if damage or any other abnormal conditions are found through inspection.

OIL JET PIPE AND REGULATION VALVE

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Visual check

Inspection for damage or other abnormal conditions.

Apply a light pressure onto the valve with a screw driver and check that valve operates smoothly.

SECTION 4
COOLING SYSTEM

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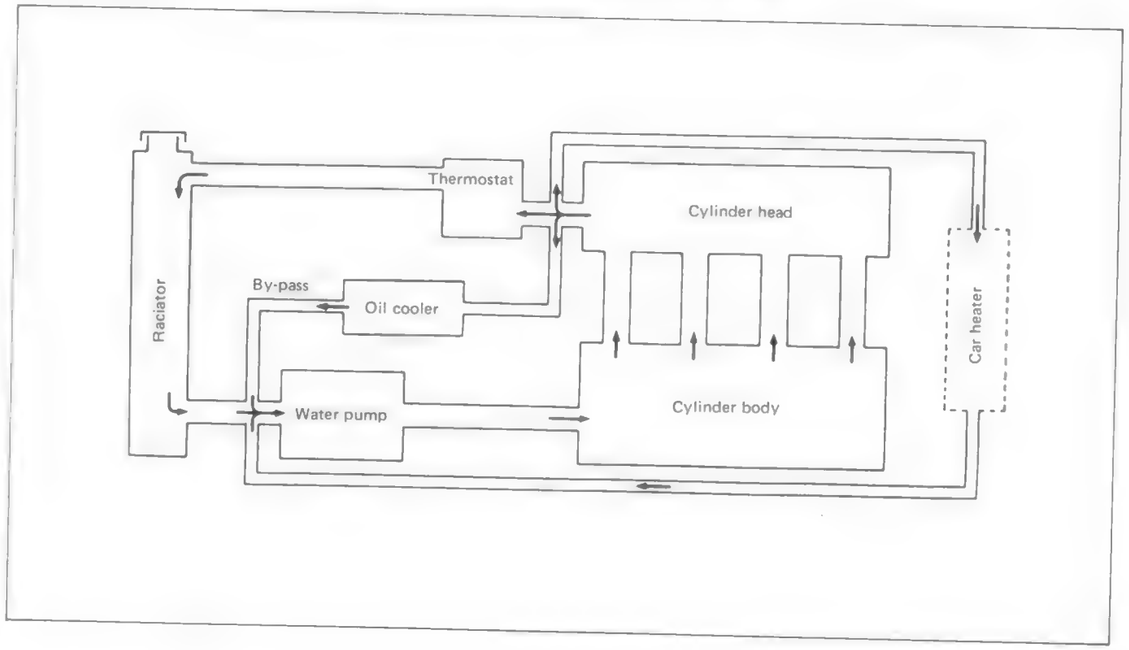
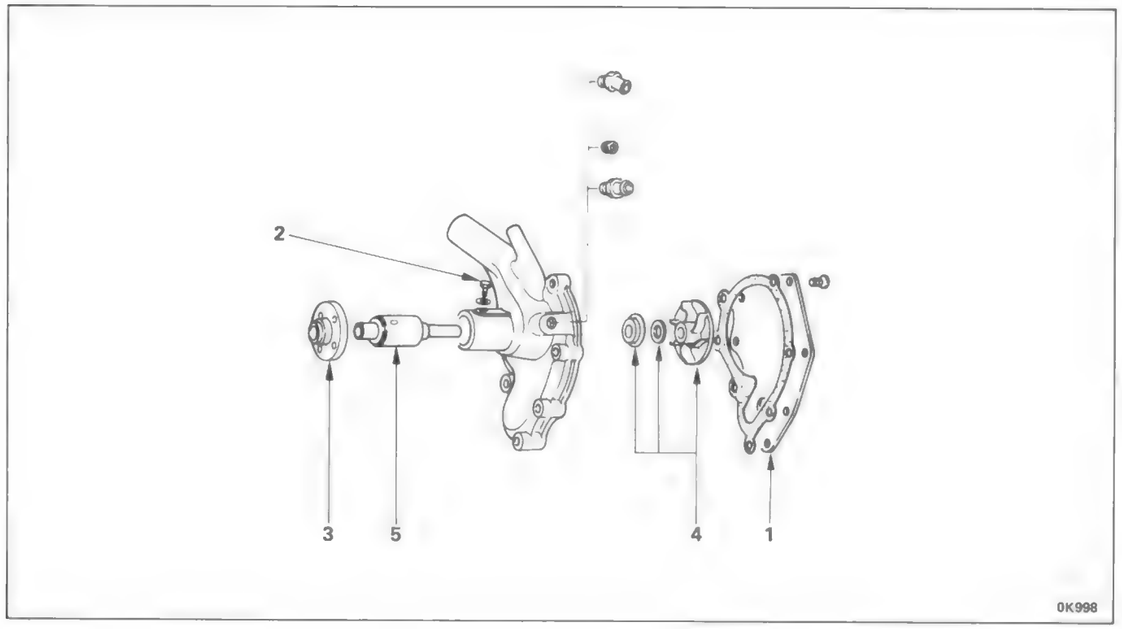
Water pump	4—2
Thermostat	4—6

GENERAL DESCRIPTION



WATER PUMP

DISASSEMBLY



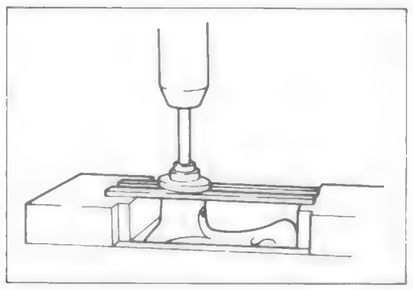
Disassembly steps

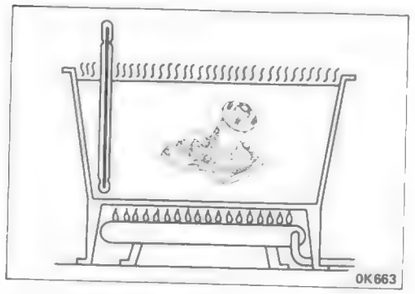
1. Cover
2. Set screw
▲ 3. Fan center
▲ 4. Impeller and seal unit
5. Bearing unit

Important operation

3. Fan center

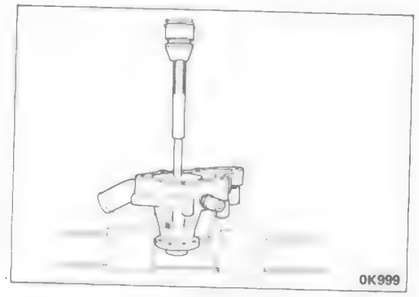
Remover.





4. Impeller and seal unit

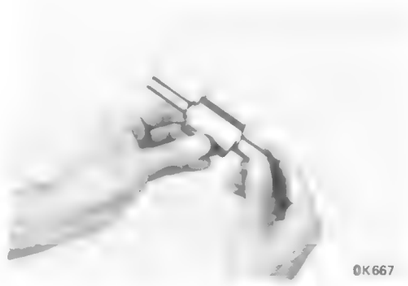
For aluminum body only.
Heat the pump body in hot water (80 ~ 90°C).



Remove impeller using a bench press and a suitable bar.

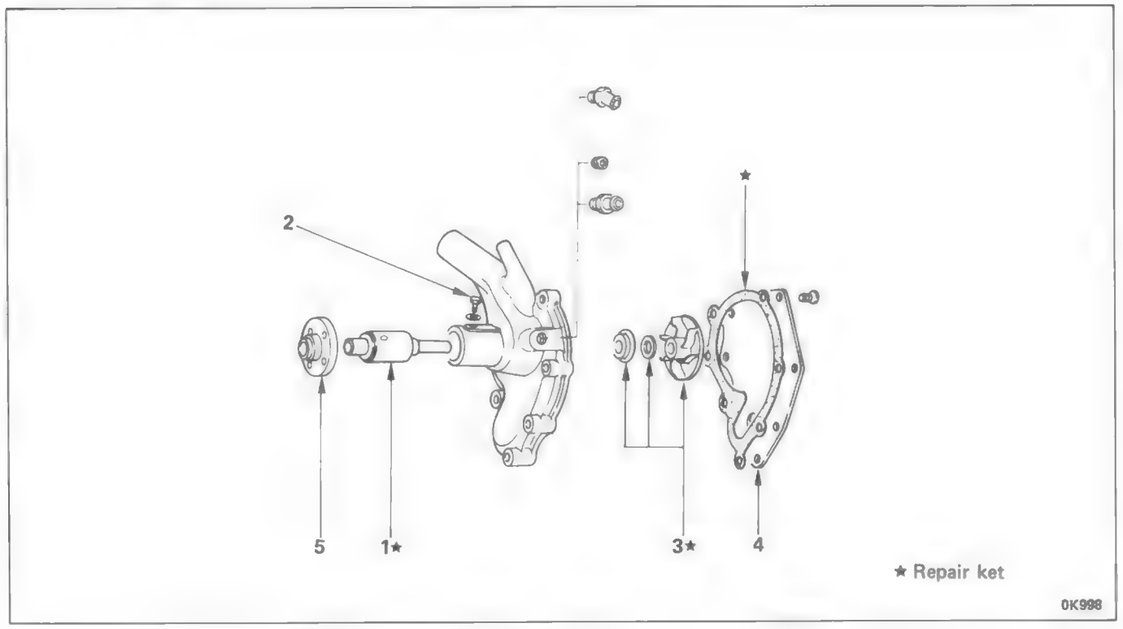
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.



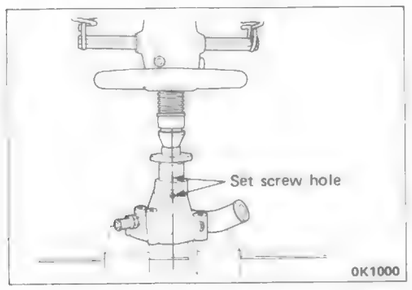
Check the bearing for abnormal noise, binding and other abnormal conditions.

REASSEMBLY



Reassembly steps

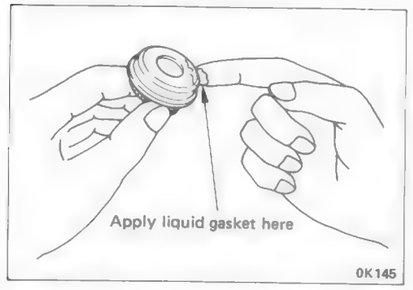
- ▲1. Bearing unit
- 2. Set screw
- ▲3. Impeller and seal unit
- 4. Cover
- ▲5. Fan center



Important operations

1. Bearing unit

Press the bearing unit into place by aligning set screw hole in bearing with that in the pump body, then secure the bearing unit in position with the screws.



3. Impeller and seal unit

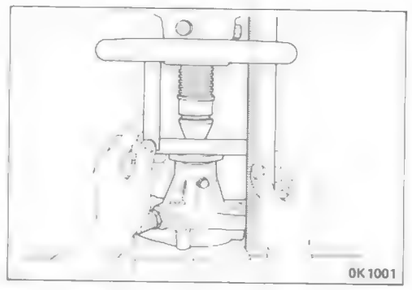
Apply a thin coat of liquid gasket; BELCO BOND No.4 to the outer periphery of seal unit before installing the seal unit.

Install the impeller in position using bench press, so that the specified clearance is provided between the impeller and pump body.

Clearance	(mm)	0.3 — 0.6

After installation, check that rear face of the impeller is indented from the face of the pump body.

Depth	(mm)	1



5. Fan center

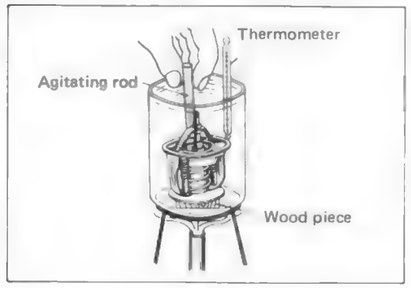
Distance between fan fitting face and rear face of the rear cover.

Distance	(mm)	110.7 — 111.3

THERMOSTAT

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Valve opening temperature	Valve lift at testing temperature
82°C	8mm at 95°C

SECTION 5
FUEL SYSTEM

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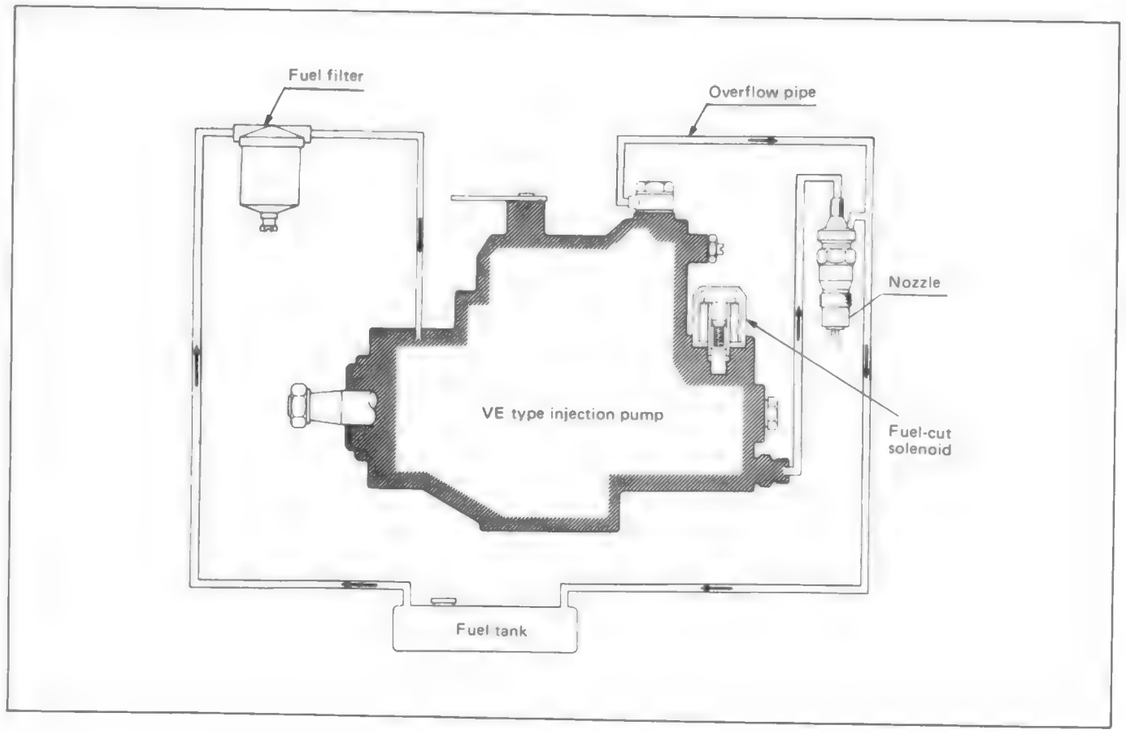
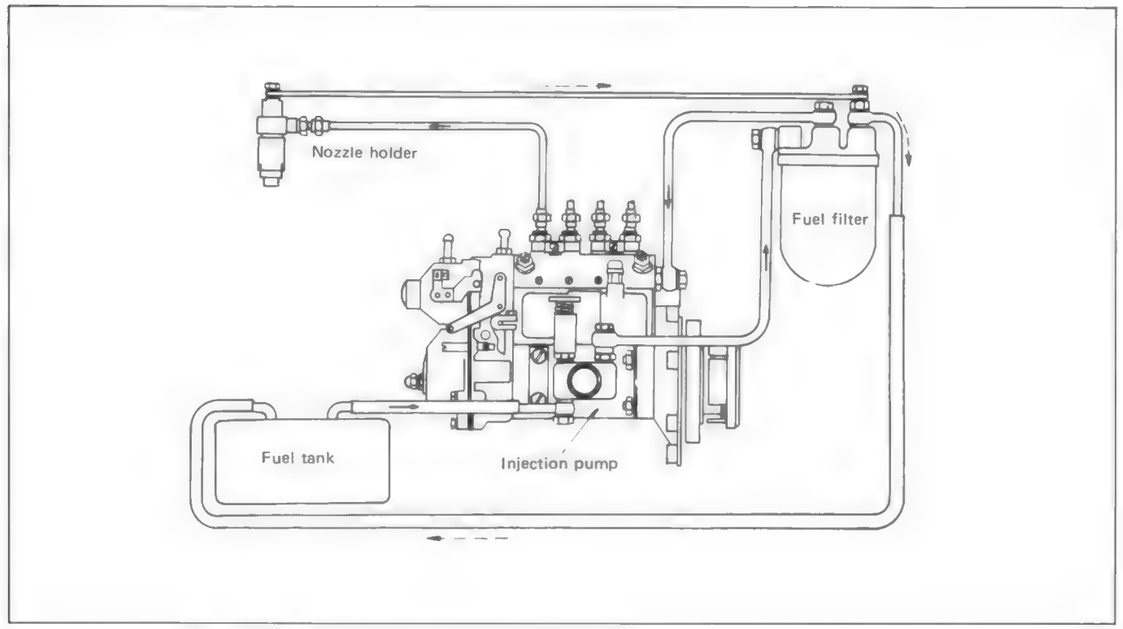
Injection nozzle ..... 5—3
Injection pump data ..... 5—4

GENERAL DESCRIPTION

C190GB model

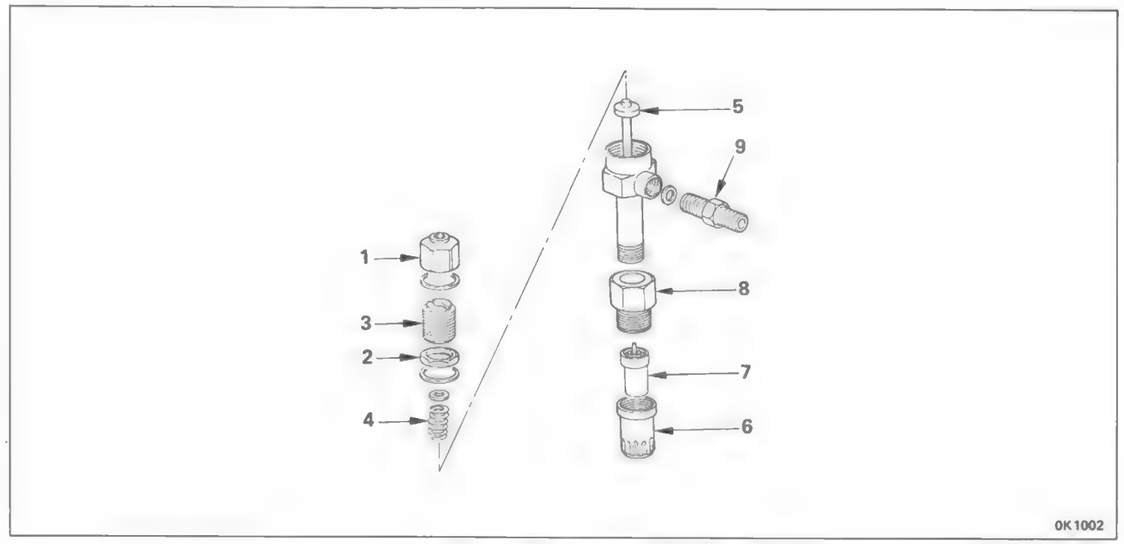


C190, C240 models



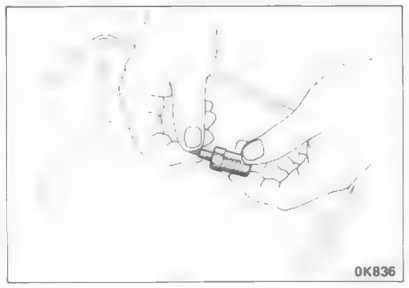
INJECTION NOZZLE

DISASSEMBLY



Disassembly steps

1. Screw cap nut
2. Nut
3. Adjusting screw
4. Nozzle spring
5. Push rod
6. Nozzle nut
- ▲7. Nozzle
8. Nozzle holder screw
9. Connector
10. Edge filter



Important operation

7. Nozzle

After removal of nozzle assembly from the nozzle body, keep them separate to maintain proper needle valve to body combinations.

REASSEMBLY

To reassemble, follow the disassembly procedure in reverse order.
Refer to "FUEL SYSTEM" in section 1 "General information" on page 1 — 19 for injection of spraying condition and injection starting pressure adjustment.

INJECTION PUMP DATA
(C190GB, C190KE models)

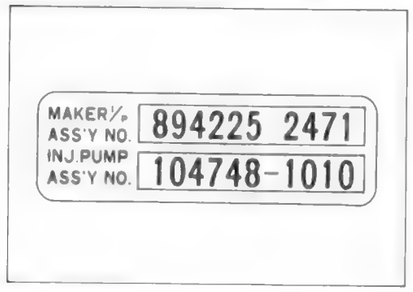
INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

Injection nozzle	★D.K.K.C. P.No.105780-0000 Bosch type No.DN12SD12T
Injection nozzle holder	D.K.K.C. P.No.105780-2080 Bosch type No.EF8511/9A
Injection starting pressure	150kg/cm²
Injection line	Inner dia. 2mm x Outer dia. 6mm — Length 840mm
Transfer pump pressure	0.2kg/cm²
Test diesel fuel	Bosch oil OL61V11 SAE standard test oil (SAE 967.C)
Testing oil temperature	46 — 54°C
Identification number	104749—1020, 104749—1030

★ D.K.K.C. ..... Diesel Kiki Co., Ltd.

IDENTIFICATION PLATE AND NUMBER



When adjusting injection volume, use the correct data following the injection pump identification number.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749—1030

Test diesel fuel : Bosch diesel fuel OL61V11

1. Settings	Pump Speed (rpm)	Fuel delivery (cc/1000st.)
1.1 Idle speed regulation	315	4.7—8.7
1.2 Start	100	Above 58

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 0.9—21	1500 3.6—4.2	2300 7.0—7.8
2.2 Supply pump	N = rpm kg/cm²	1000 3.9—4.5	1500 5.3—5.7	2150 6.6—7.2
Overflow delivery	N = rpm cc/10s	1000 48—91		

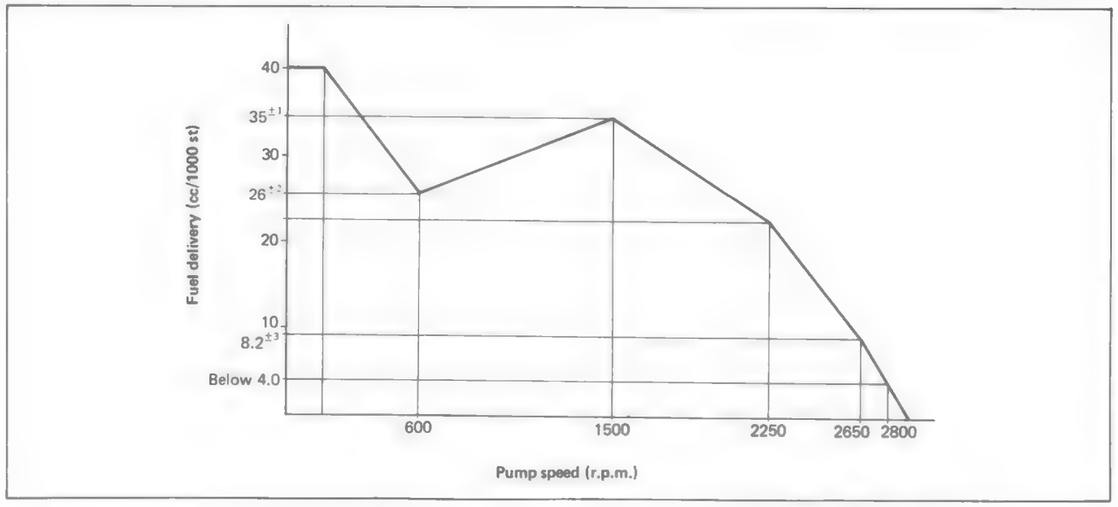
2.3 Fuel deliveries

Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	1500	34.6—36.6
	600	24.4—28.4
	2225	30.3—34.3
	2650	5.2—11.2
	2800	Below 4.1
Switch-off	315	0
Idle stop	315	4.7—8.7
	365	Below 3.6
Cold start device	0	1.9—2.3mm
	560—760	Cancel
2.4 Solenoid	Max. cut-in voltage	8V
	test voltage	12V—14V

3. Dimensions	
Desig-nation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	7.5—11 mm
β	36—46 deg.
B	10.5—14.6 mm
Observations	

N : Pump speed

GOVERNOR PERFORMANCE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749–1030

Test diesel fuel : SAE standard test diesel fuel SAE967C

1. Settings	Pump Speed (rpm)	Fuel delivery (cc/1000st.)
1.1 Idle speed regulation	315	4.5–8.5
1.2 Start	100	Above 57

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 0.9–2.1	1500 3.5–4.1	2300 6.9–7.8
2.2 Supply pump	N = rpm kg/cm²	1000 3.8–4.4	1500 5.2–5.6	2150 6.5–7.1
Overflow delivery	N = rpm cc/10s	1000 52–95		

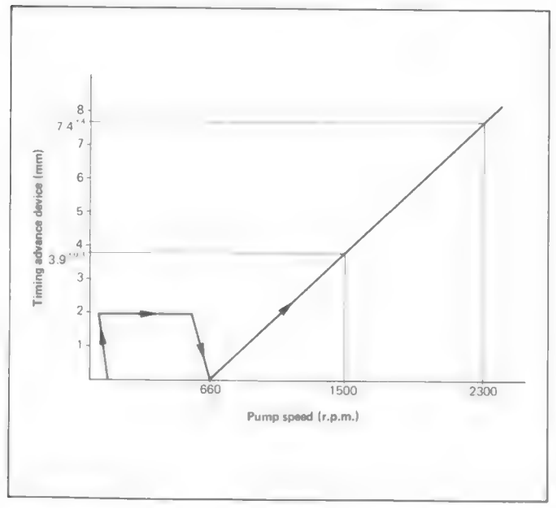
2.3 Fuel deliveries

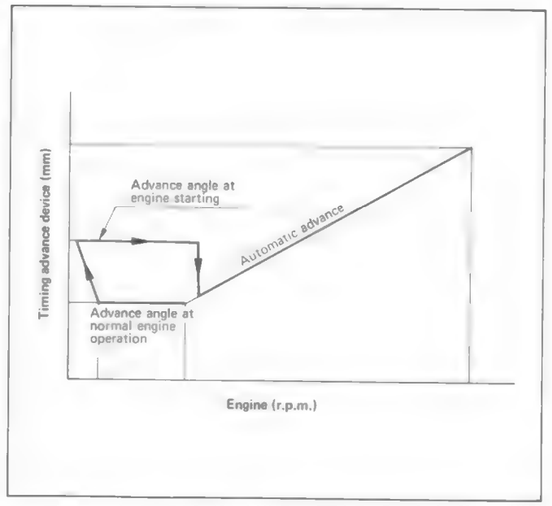
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	1500 600 2225 2650 2800	33.7–35.7 23.8–27.8 29.5–33.5 5.0–11.0 Below 4
Switch-off	315	0
Idle stop	315 365	4.5–8.5 Below 3.5
Cold start device	0 600–800	1.9–2.3mm Cancel
2.4 Solenoid	Max. cut-in voltage test voltage	12V

3. Dimensions	
Desig-nation	For assembly and adjustment (mm)
K KF MS	3.2–3.4 5.7–5.9 1.7–1.9
α A	21–29 deg. 7.5–11 mm
β B	36–46 deg. 10.5–14.5 mm
Observations	

N : Pump speed

TIMING DEVICE DIAGRAM





INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749–1020

Test diesel fuel : Bosch diesel fuel OL61V11

1. Settings	Pump Speed (rpm)	Fuel delivery (cc/1000st.)
1.1 Idle speed regulation	315	4.7–8.7
1.2 Start	100	Above 58

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 0.9–2.1	1500 3.6–4.2	2300 7.0–7.8
2.2 Supply pump	N = rpm kg/cm²	1000 3.9–4.5	1500 5.3–5.7	2150 6.6–7.2
Overflow delivery	N = rpm cc/10s	1000 48–91		

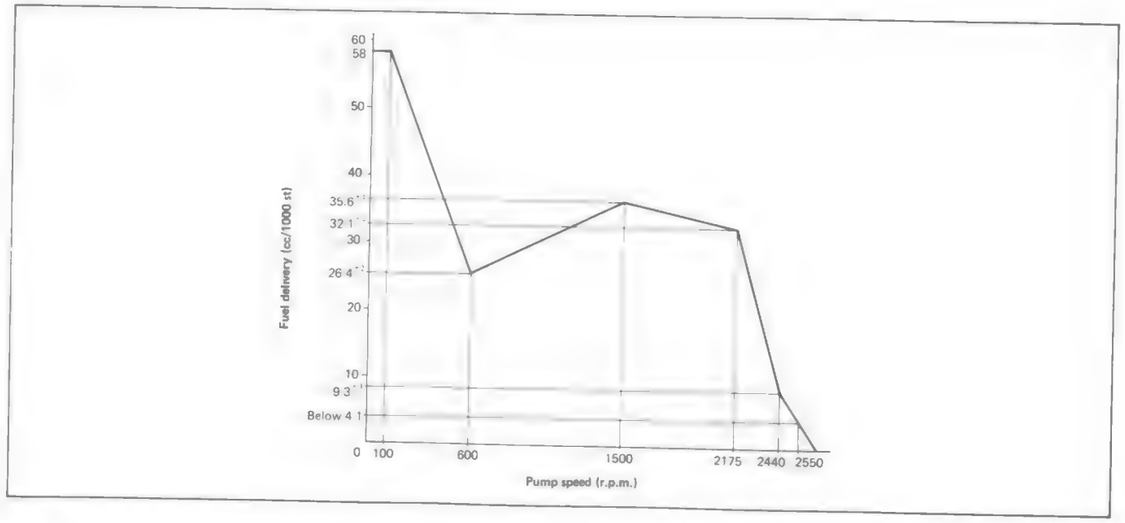
2.3 Fuel deliveries

Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	1500 600 2175 2440 2550	34.6–36.6 24.4–28.4 30.1–34.1 6.3–12.3 Below 4.1
Switch-off	315	0
Idle stop	315 365	4.7–8.7 Below 3.6
Cold start device	0 560–760	1.9–2.3mm Cancel
2.4 Solenoid	Max. cut-in voltage test voltage	12–14V

3. Dimensions	
Desig-nation	For assembly and adjustment (mm)
K KF MS	3.2–3.4 5.7–5.9 1.7–1.9
α A	21–29 deg. 7.5–11 mm
β B	36–46 deg. 10.5–14.5 mm
Observations	

N : Pump speed

GOVERNOR PERFORMANCE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749—1020

Test diesel fuel : SAE standard test diesel fuel SAE987C

1. Settings	Pump Speed (rpm)	Fuel delivery (cc/1000st.)
1.1 Idle speed regulation	315	4.5—8.5
1.2 Start	100	Above 57

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 0.9—2.1	1500 3.6—4.1	2300 6.9—7.8
2.2 Supply pump	N = rpm kg/cm²	1000 3.8—4.4	1500 5.2—5.6	2150 6.5—7.1
Overflow delivery	N = rpm cc/10s	1000 52—95		

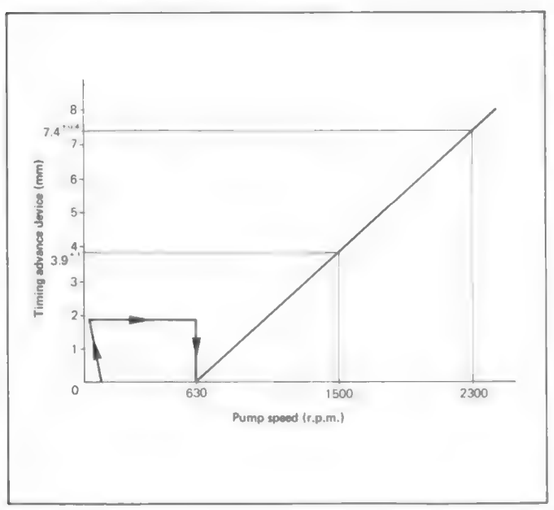
2.3 Fuel deliveries

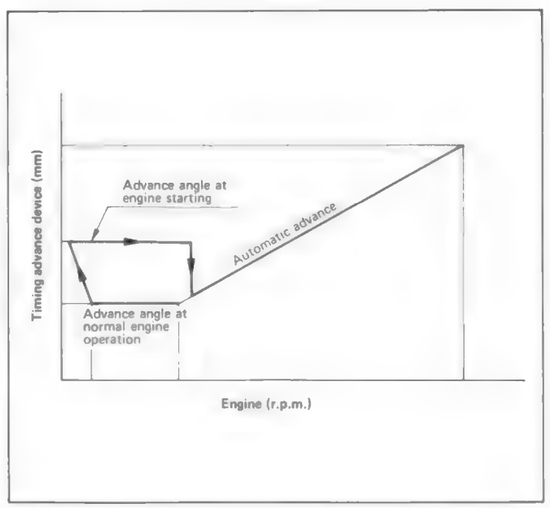
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	1500 600 2175 2440 2550	33.7—35.7 23.8—27.8 29.3—33.3 6.1—12.1 Below 4
Switch-off	315	0
Idle stop	315 365	4.5—8.5 Below 3.5
Cold start device	0 600—800	1.9—2.3mm Cancel
2.4 Solenoid	Max. cut-in voltage test voltage	12V

3. Dimensions	
Desig-nation	For assembly and adjustment (mm)
K KF MS	3.2—3.4 5.7—5.9 1.7—1.9
α A	21—29 deg. 7.5—11 mm
β B	36—46 deg. 10.5—14.5 mm
Observations	

N : Pump speed

TIMING DEVICE DIAGRAM





INJECTION PUMP DATA (C190, C240 models)

INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

Injection nozzle	★D.K.K.C. P.No.105780-0000 Bosch type No.DN12SD12T
Injection nozzle holder	D.K.K.C. P.No.105780-2080 Bosch type No.EF8511/9A
Injection starting pressure	175kg/cm²
Injection line	Inner dia. 2mm x Outer dia. 6mm — Length 600mm
Transfer pump pressure	1.6kg/cm²
Test diesel fuel	Bosch oil OL61V11 (Shell V-oil 1253) SAE standard test oil (SAE 967C)
Testing oil temperature	40 — 45°C
Identification number C190 C240	101421—4980, 101421—7020, 101421—4870 101431—0550

★ D.K.K.C. ..... Diesel Kiki Co., Ltd.

IDENTIFICATIONS PLATE AND NUMBER

The injection volume should be adjusted by refering to the adjustment data applicable to the specific injection pump model as identified by Ⓐ.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification No. : 101421—4980, 101421—7027

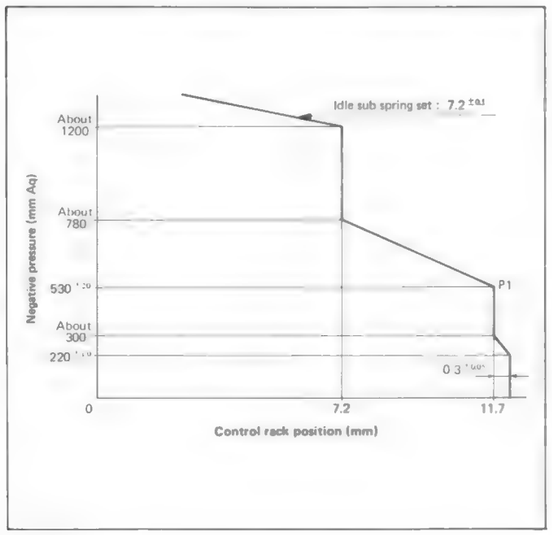
Bosch oil OL61V11

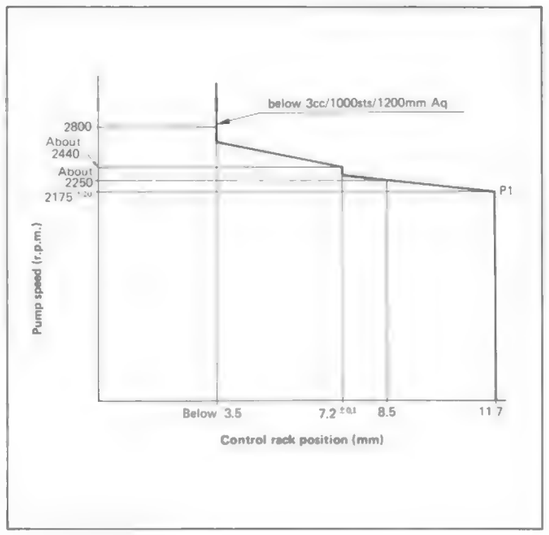
Control rack position (mm)	Pump speed (rpm)	Injection volume (cc/1000st.)	Deviation (%)	Remarks
11.7	1800	37.6—39.4	± 2.5	Basic
About 7.2	300	6.8—9.0	±14	
	150	Above —54	—	

SAE standard test oil

Control rack position (mm)	Pump speed (rpm)	Injection volume (cc/1000st.)	Deviation (%)	Remarks
11.7	1800	36.1—37.9	± 2.5	Basic
About 7.2	300	5.9—8.1	±14	
	150	Above —52	—	

GOVERNOR PERFORMANCE DIAGRAM





INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification No. : 101421—4870

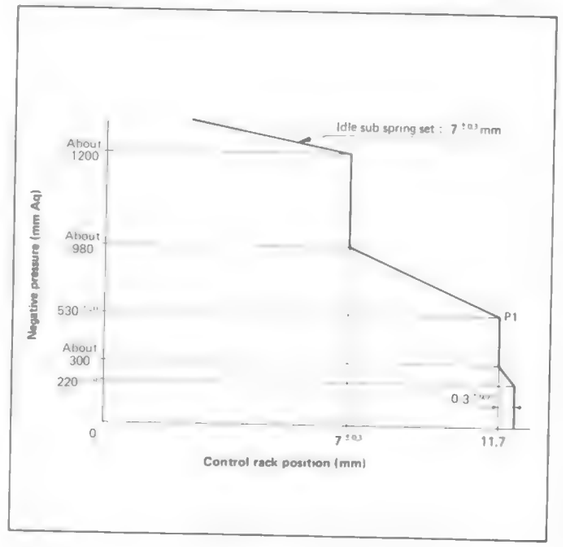
Bosch oil OL61V11

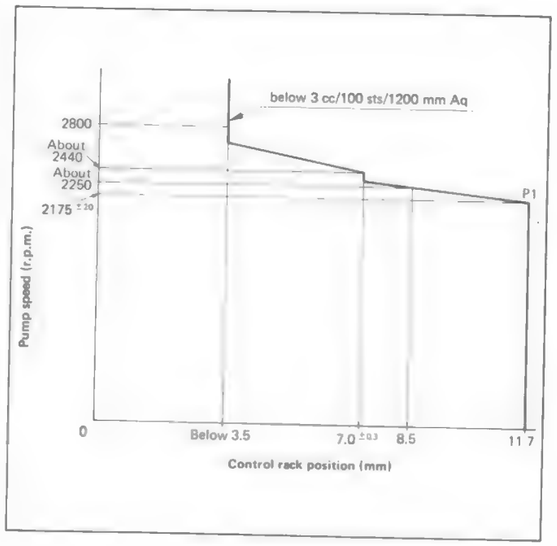
Control rack position (mm)	Pump speed (rpm)	Injection volume (cc/1000st.)	Deviation (%)	Remarks
11.7	1800	37.6—39.4	± 2.5	Basic
About 7.2	300	6.8—9.0	±14	
	150	Above —54	—	

SAE standard test oil

Control rack position (mm)	Pump speed (rpm)	Injection volume (cc/1000st.)	Deviation (%)	Remarks
11.7	1800	36.1—37.9	± 2.5	Basic
About 7.2	300	5.9—8.1	±14	
	150	Above —54	—	

GOVERNOR PERFORMANCE DIAGRAM





INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification No. : 101431—0550

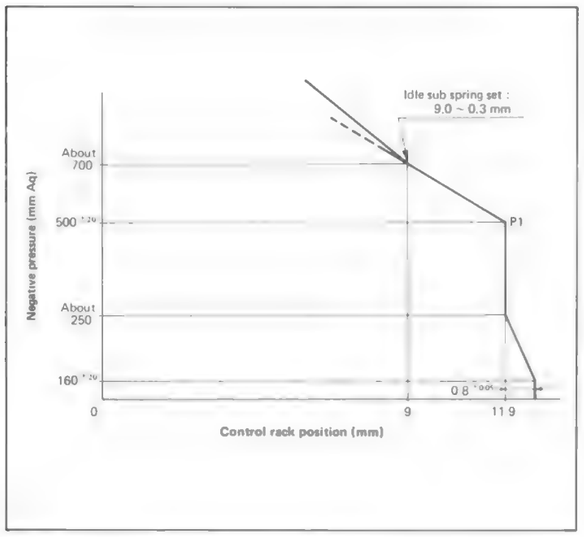
Bosch oil OL61V11

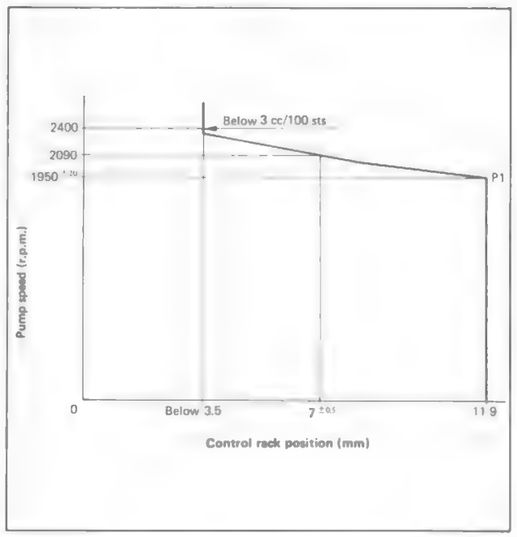
Control rack position (mm)	Pump speed (rpm)	Injection volume (cc/1000st.)	Deviation (%)	Remarks
11.9	1900	42.7—44.7	± 2.5	Basic
8.4	300	7.9—10.1	±14	

SAE standard test oil

Control rack position (mm)	Pump speed (rpm)	Injection volume (cc/1000st.)	Deviation (%)	Remarks
11.9	1900	41.0—43.0	± 2.5	Basic
8.4	300	6.9—9.1	±14	

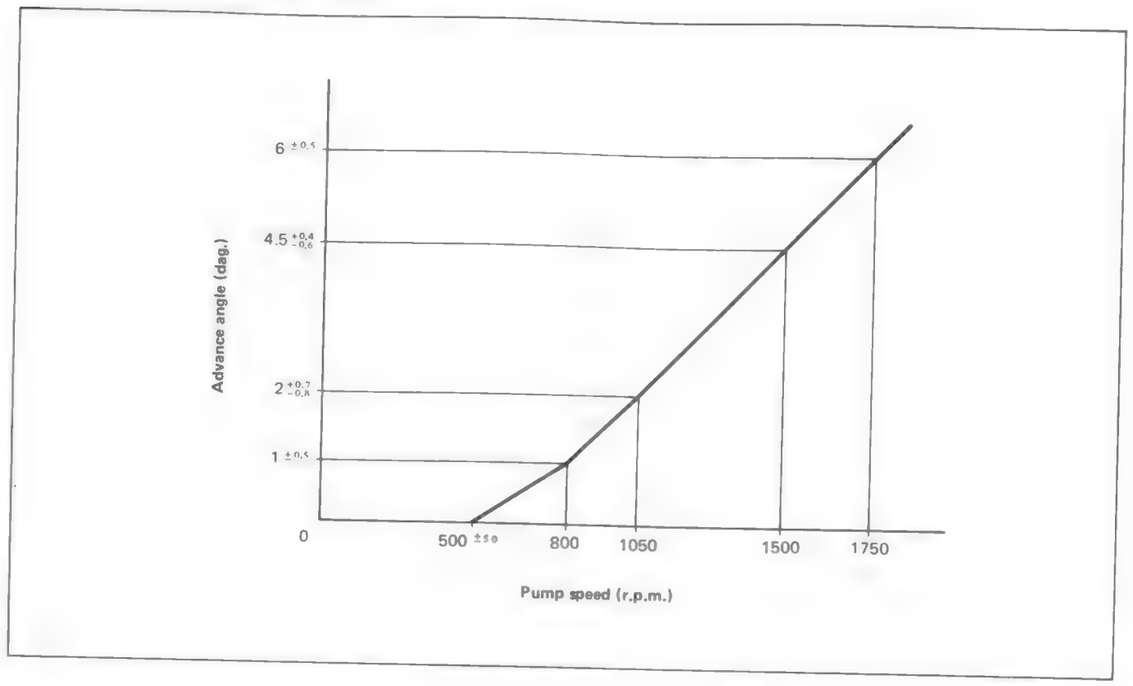
GOVERNOR PERFORMANCE DIAGRAM



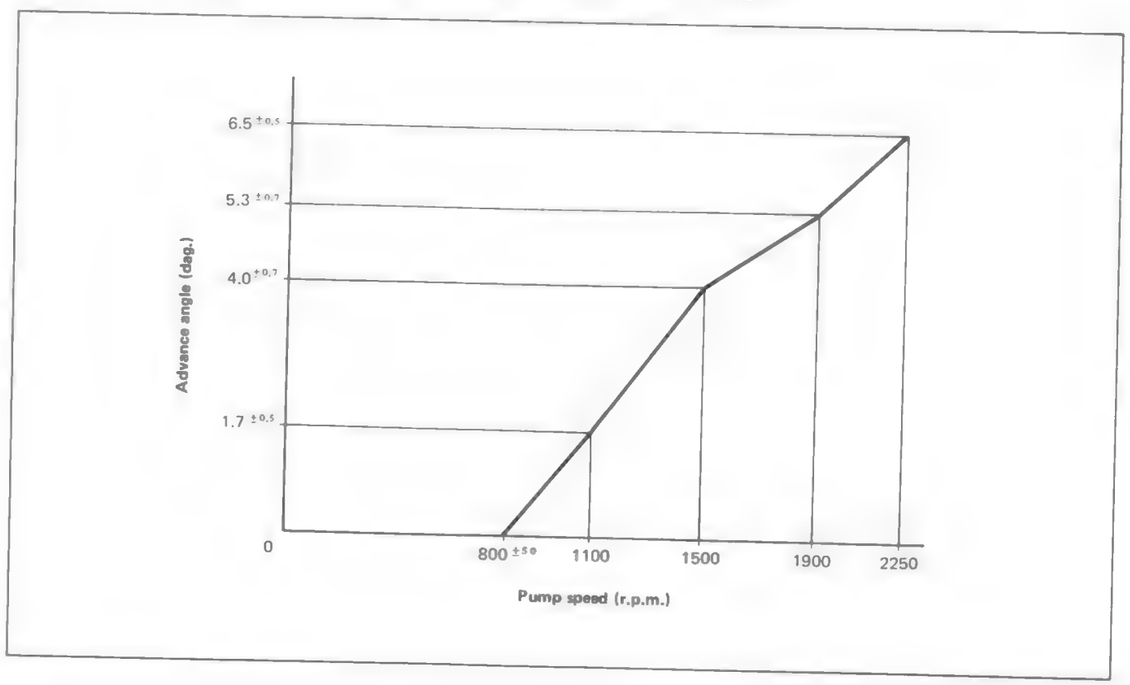


AUTOMATIC TIMER CHARACTERISTIC DIAGRAM

Identification No.: 101431—0550



Identification No.: 101421—7020, 101421—4870, 101421—7020



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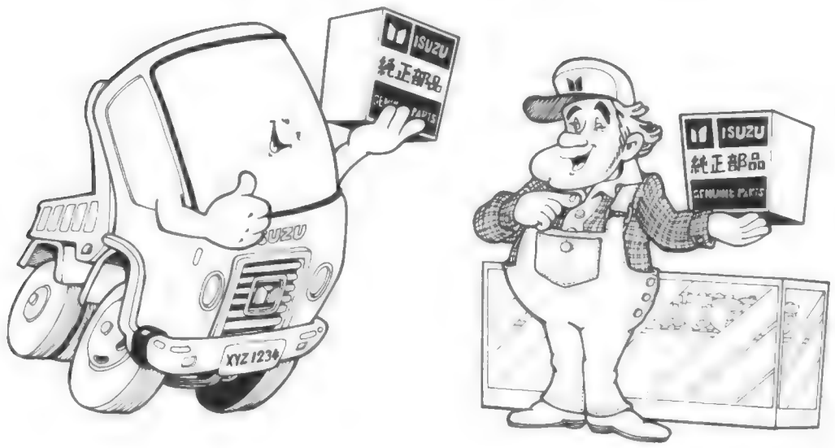

SECTION 6

INTAKE AND EXHAUST SYSTEM

INDEX

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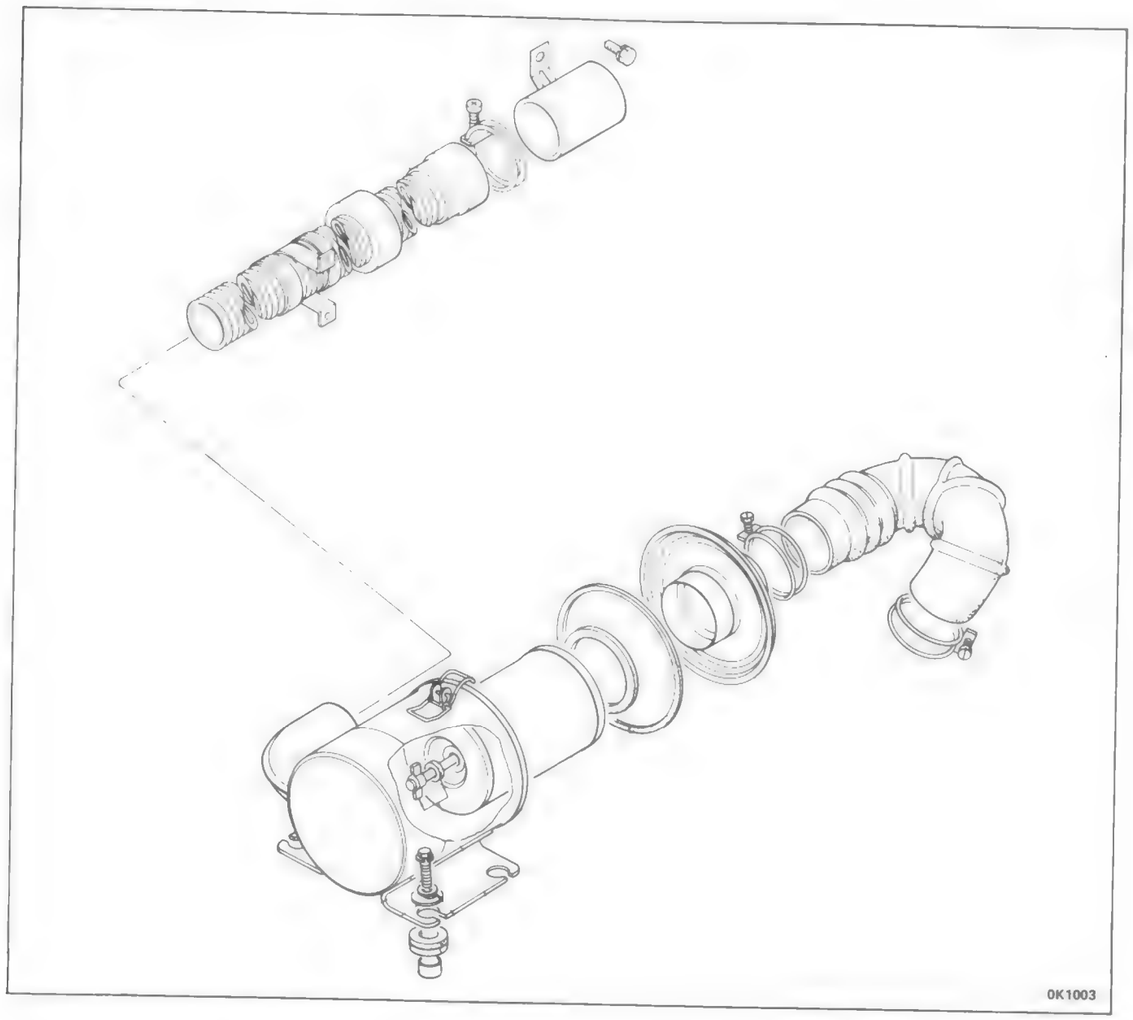
General description — Intake system ..... 6—1
General description — Exhaust system ..... 6—5

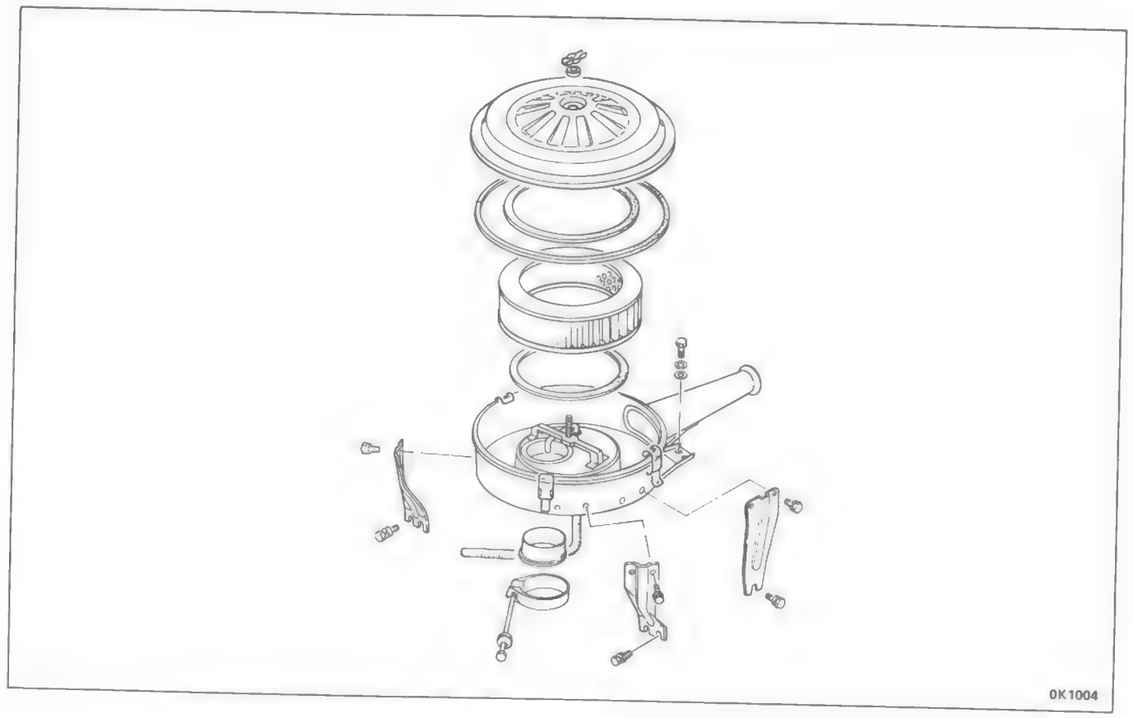
GENERAL DESCRIPTION

INTAKE SYSTEM

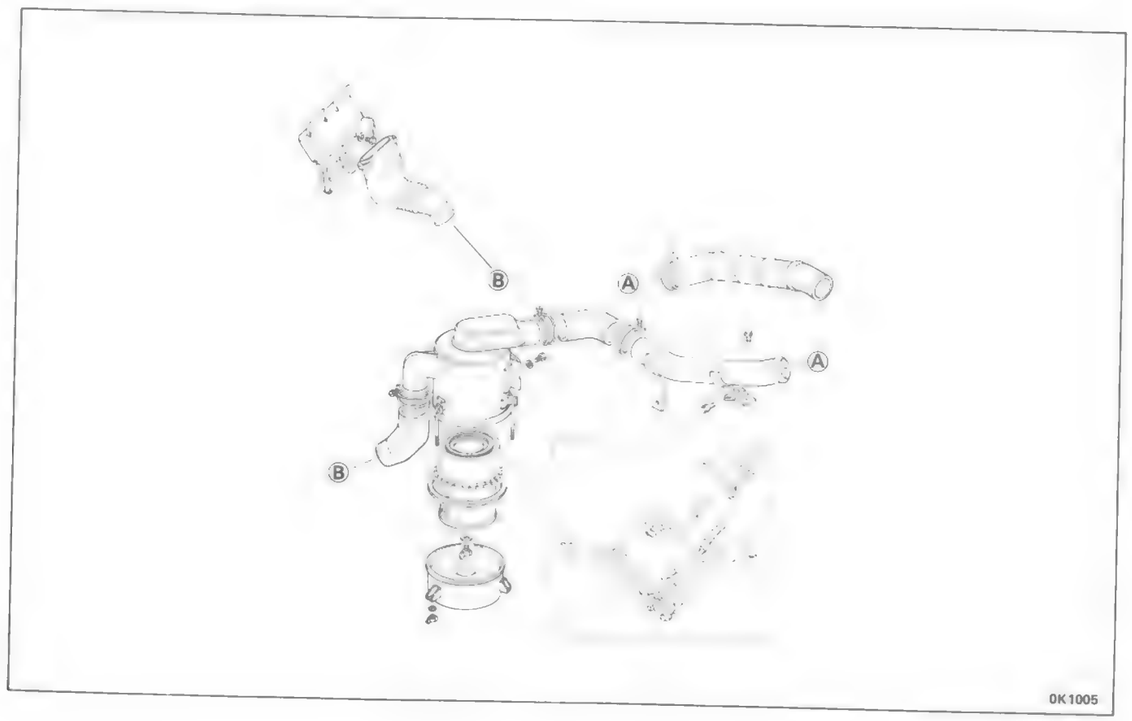
PAD model



KBD model

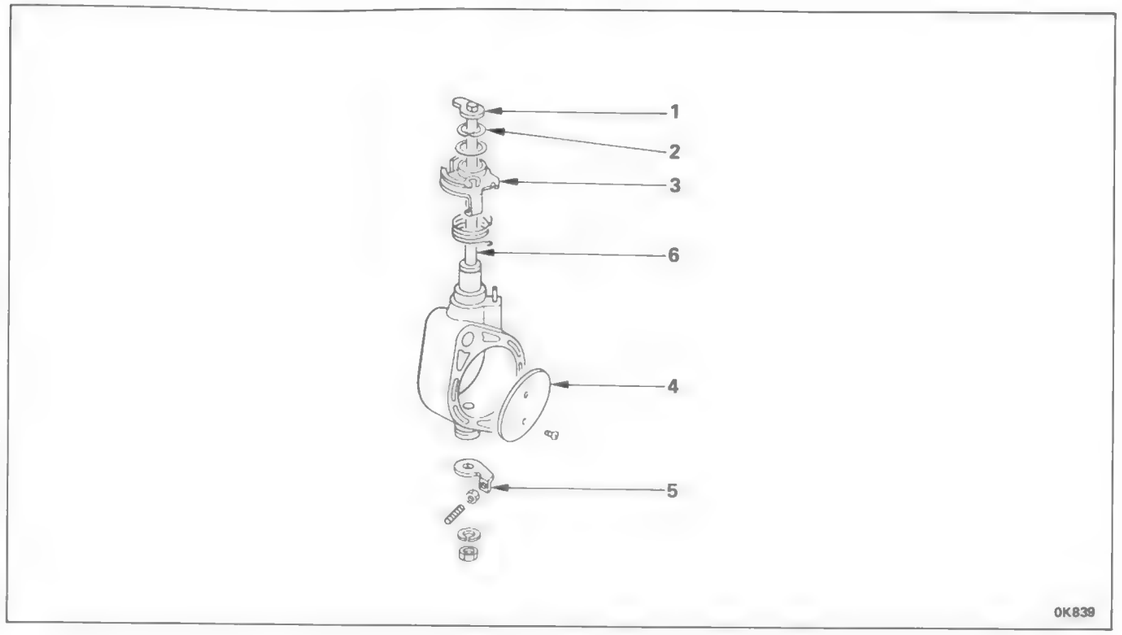


KAD and TLD models



INTAKE MANIFOLD AND INTAKE SHUTTER

DISASSEMBLY



Disassembly steps

1. Intake shutter lever
2. Snap ring
3. Intake shutter lever
4. Intake shutter valve
5. Stopper lever
6. Intake shutter shaft

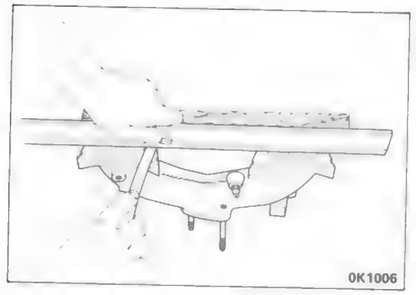
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Clearance between shaft and bushing.

(mm)

Standard	Limit
0.04 — 0.12	0.2



Intake manifold

Check cylinder head fitting face of the intake manifold for distortion.

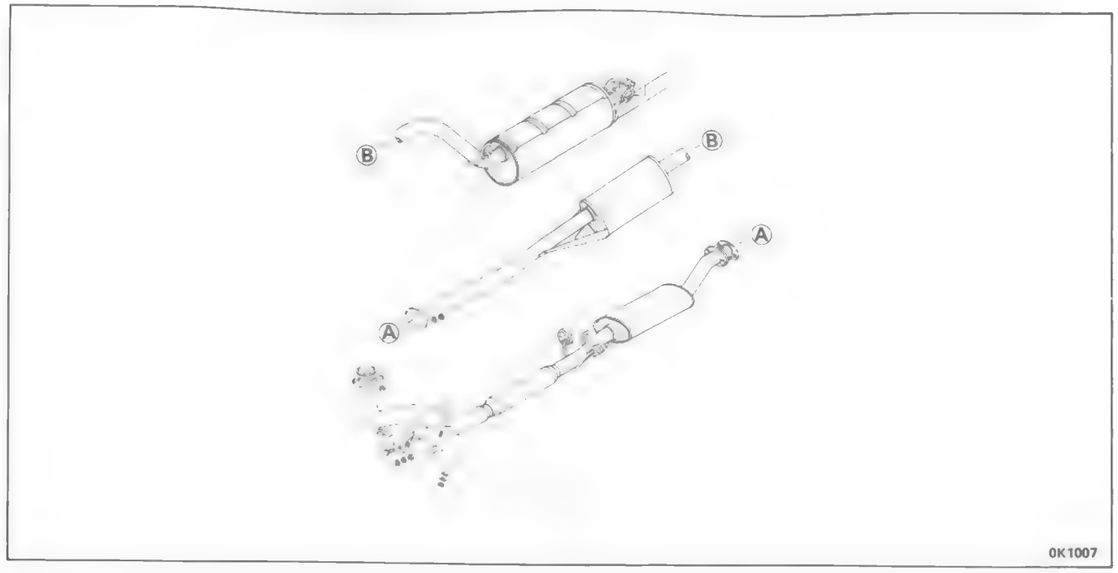
Limit	(mm)	0.4

REASSEMBLY

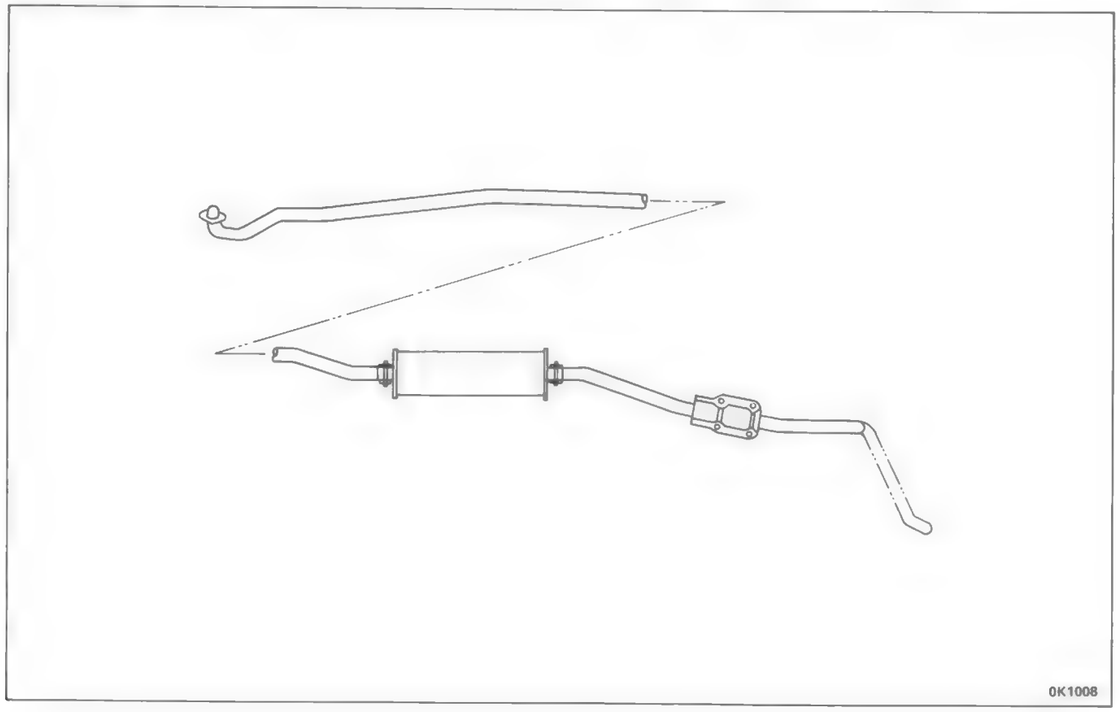
To reassemble, follow the disassembly procedure in reverse order.

EXHAUST SYSTEM

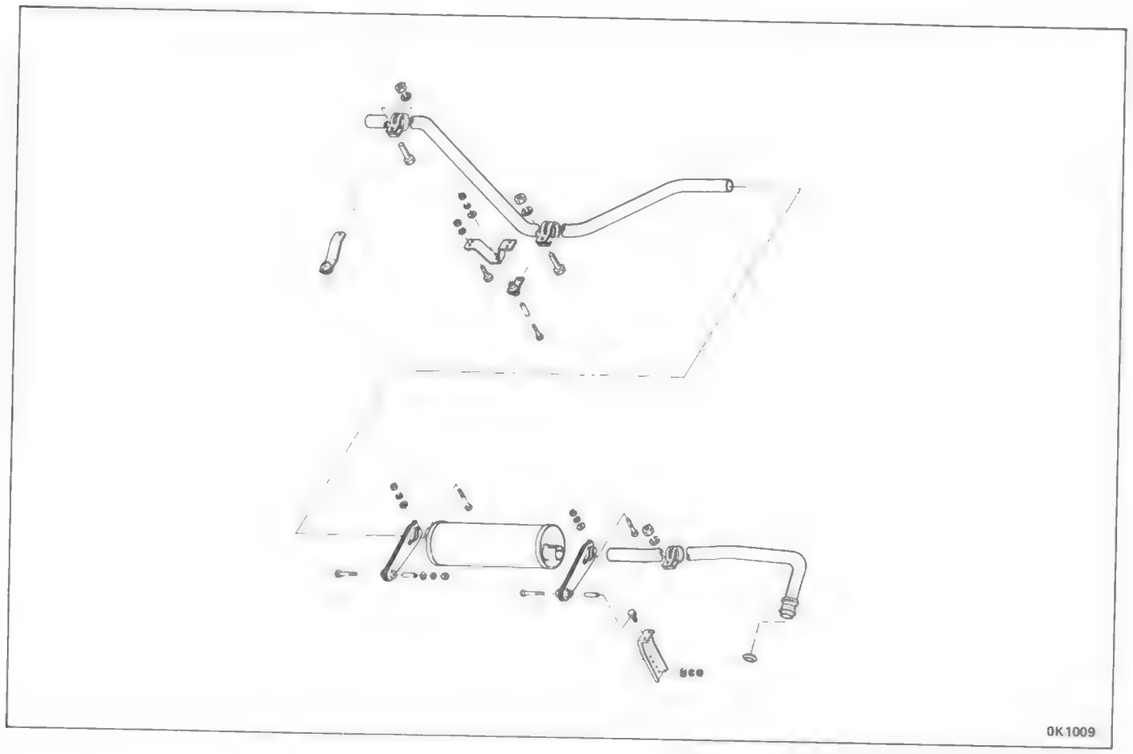
PAD model



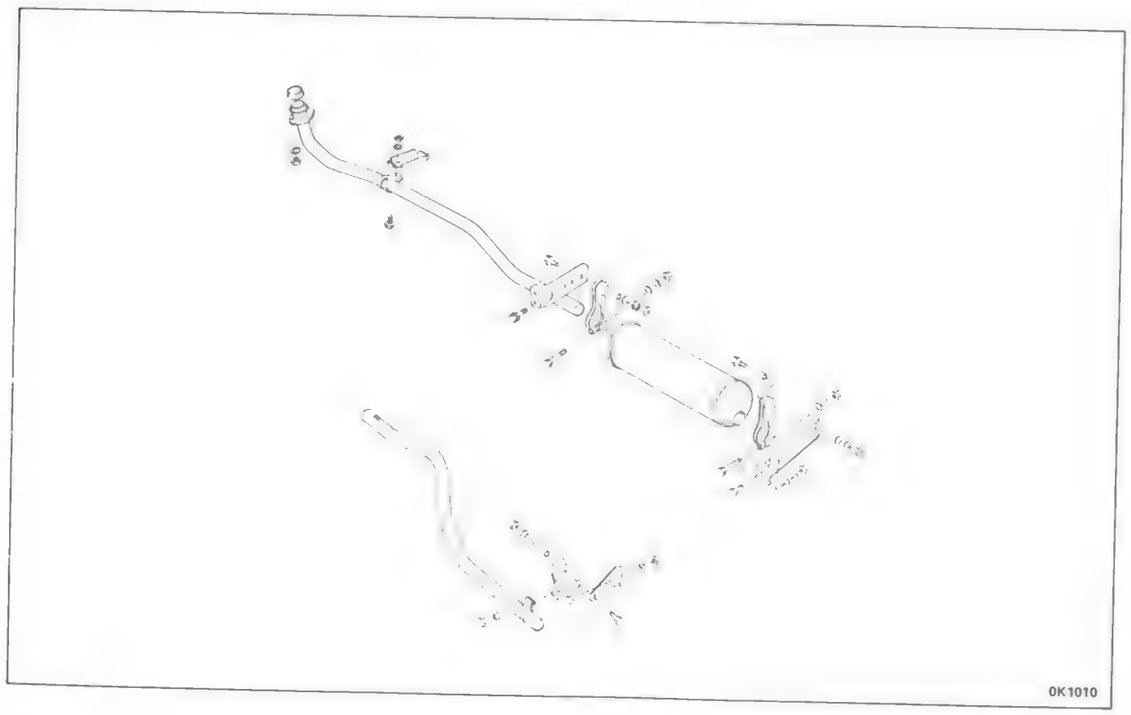
KBD model



KAD model



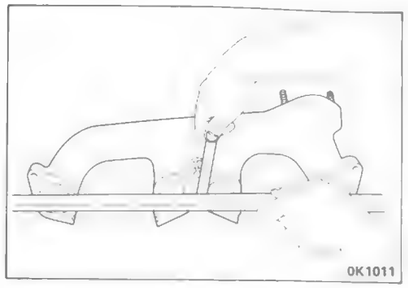
TLD model



EXHAUST MANIFOLD

INSPECTION AND REPAIR

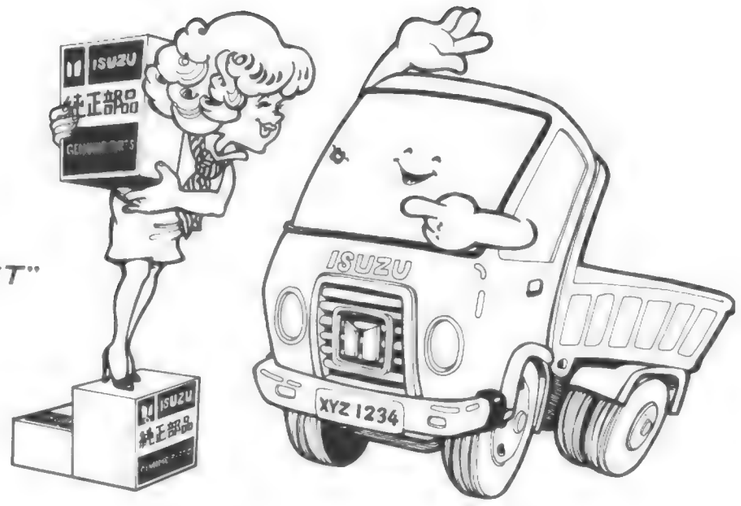
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Check cylinder head fitting face of the manifold for distortion.

Limit	(mm)	0.4

MEMO



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SECTION 7

AUXILIARIES

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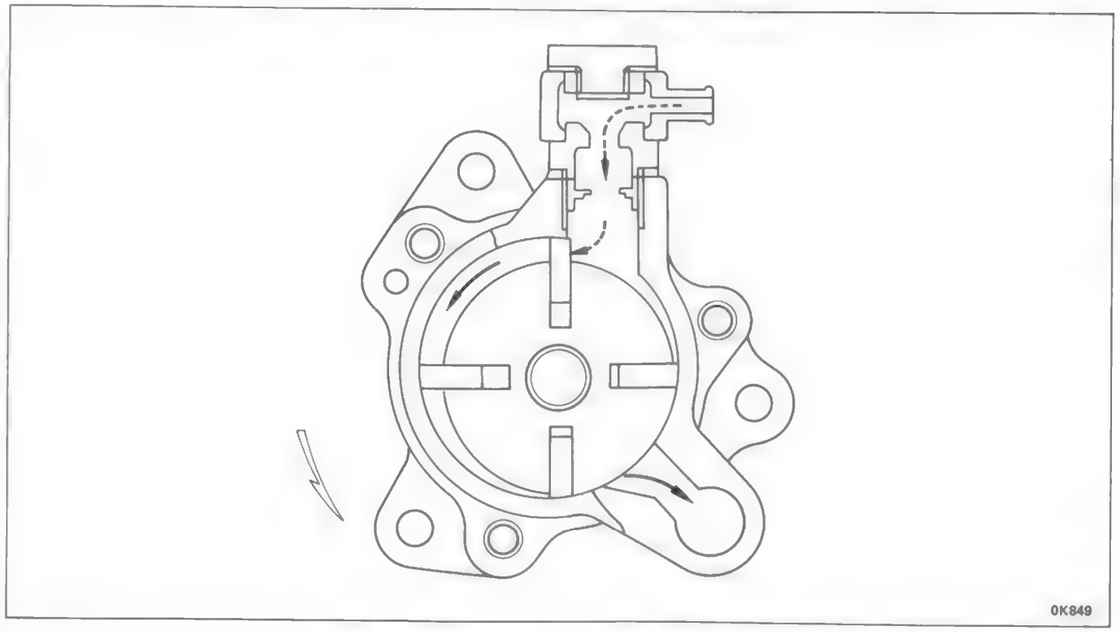
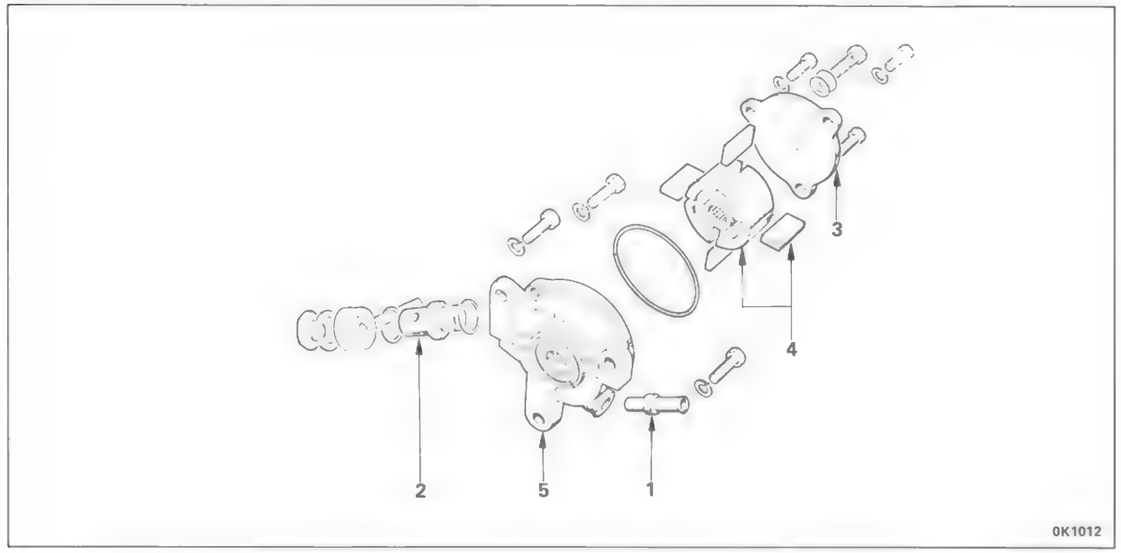
Vacuum pump 7–1

VACUUM PUMP



DISASSEMBLY

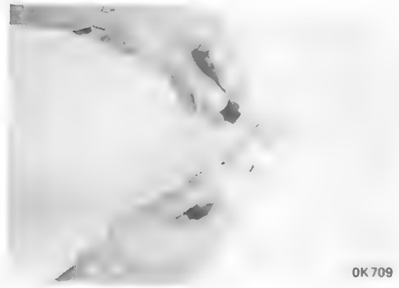


Disassembly steps

1. Vacuum pipe connector
2. Connecting bolt and connecting ring
3. Cover
4. Rotor assembly
5. Housing
6. Flange

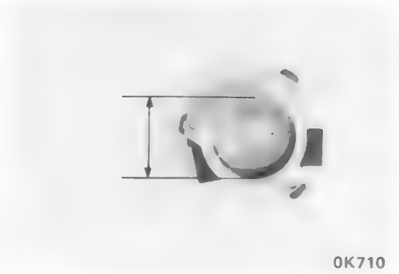
INSPECTION

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Measure the length of vanes.

Standard	(mm)	13 — 14



Measure the inside diameter of housing

Standard	(mm)	57.0 — 57.1

REASSEMBLY

To assemble, follow the disassembly procedure in reverse order.

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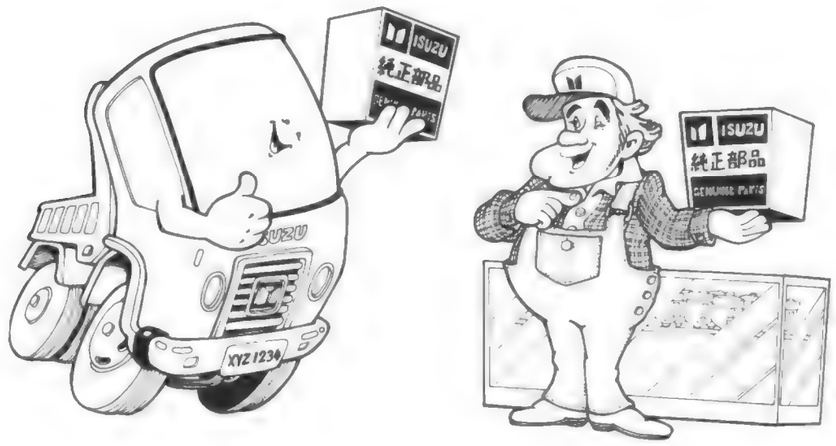
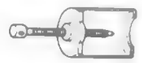
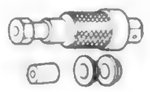
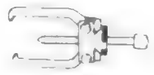


SECTION 8

SPECIAL TOOL LIST

ITEM NO.	ILLUSTRATION	PARTS NO.	PARTS NAME	PAGE
1.		5-83571-002-0	Compression gauge adaptor	1-19
2.		5-85210-016-0	Steering wheel remover	2-17
3.		9-8523-1423-0	Valve spring compressor	2-19 2-42
4		9-8523-2552-0 (+A)	Cylinder liner remover	2-22
5.		(A) 9-8522-1148-0	Grip	2-22
6.		9-8523-2551-0	Cylinder liner installer	2-23
7.		9-8521-0074-0	Crankshaft timing gear remover	2-25
8.		9-8521-0021-0	Crankshaft timing gear installer	2-25 2-47
9.		9-8523-1812-0	Crankshaft pilot bearing remover	2-26

ITEM NO.	ILLUSTRATION	PARTS NO.	PARTS NAME	PAGE
10.		9-8523-1369-0	Piston pin bushing remover & installer	2-29
11.		5-85230-002-0	Valve guide remover & installer	2-33
12.		9-8523-1737-0 9-8523-1360-0	Camshaft pilot bearing remover & installer	2-36
13.		5-85210-002-0	Universal puller	2-36 2-36
14.		5-85220-013-0	Crankshaft front oil seal installer	2-40
15.		9-8522-1279-0	Crankshaft rear oil seal installer	2-47
16.		9-8522-1255-0	Piston ring compressor	2-48

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Mass	9—5
Pressure	9—6
Torque	9—7
Temperature	9—7

LENGTH

MILLIMETERS TO INCHES

mm	in	mm	in	mm	in	mm	in
1	0.0394	26	1.0236	51	2.0079	76	2.9921
2	0.0787	27	1.0630	52	2.0472	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1102
5	0.1968	30	1.1811	55	2.1653	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	3.1890
7	0.2756	32	1.2598	57	2.2441	82	3.2283
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3779	60	2.3622	85	3.3464
11	0.4331	36	1.4173	61	2.4016	86	3.3858
12	0.4724	37	1.4567	62	2.4409	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5039
15	0.5905	40	1.5748	65	2.5590	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6535	67	2.6378	92	3.6220
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7165	94	3.7008
20	0.7874	45	1.7716	70	2.7559	95	3.7401
21	0.8268	46	1.8110	71	2.7953	96	3.7795
22	0.8661	47	1.8504	72	2.8346	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8976
25	0.9842	50	1.9685	75	2.9527	100	3.9370

INCHES TO MILLIMETERS

in	mm	in	mm
1/64	0.3969	33/64	13.0969
1/32	0.7937	17/32	13.4937
3/64	1.1906	35/64	13.8906
1/16	1.5875	9/16	14.2875
5/64	1.9844	37/64	14.6844
3/32	2.3812	19/32	15.0812
7/64	2.7781	39/64	15.4781
1/8	3.1750	5/8	15.8750
9/64	3.5719	41/64	16.2719
5/32	3.9687	21/32	16.6687
11/64	4.3656	43/64	17.0656
3/16	4.7625	11/16	17.4625
13/64	5.1594	45/64	17.8594
7/32	5.5562	23/32	18.2562
15/64	5.9531	47/64	18.6531
1/4	6.3500	3/4	19.0500
17/64	6.7469	49/64	19.4469
9/32	7.1437	25/32	19.8437
19/64	7.5406	51/64	20.2406
5/16	7.9375	13/16	20.6375
21/64	8.3344	53/64	21.0344
11/32	8.7312	27/32	21.4312
23/64	9.1281	55/64	21.8281
3/8	9.5250	7/8	22.2250
25/64	9.9219	57/64	22.6219
13/32	10.3187	29/32	23.0187
27/64	10.7156	59/64	23.4156
7/16	11.1125	15/16	23.8125
29/64	11.5094	61/64	24.2094
15/32	11.9062	31/32	24.6062
31/64	12.3062	63/64	25.0031
1/2	12.7000	1	25.4000

FEET TO METERS

ft.	0	1	2	3	4	5	6	7	8	9	ft.
	m	m	m	m	m	m	m	m	m	m	
—		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	—
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

METERS TO FEET

m	0	1	2	3	4	5	6	7	8	9	m
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	
—		3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	—
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	175.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

MILES TO KILOMETERS

miles	0	1	2	3	4	5	6	7	8	9	miles
	km	km	km	km	km	km	km	km	km	km	
—		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	—
10	16.093	17.703	19.312	20.921	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.593	69.202	70.811	72.421	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.779	101.390	103.000	104.610	106.220	107.830	109.440	111.040	60
70	112.650	114.260	115.870	117.480	119.090	120.700	122.310	123.920	125.530	127.140	70
80	128.750	130.360	131.970	133.580	135.190	136.790	138.400	140.010	141.620	143.230	80
90	144.840	146.450	148.060	149.670	151.280	152.890	154.500	156.110	157.720	159.330	90
100	160.930	162.540	164.150	165.760	167.370	168.980	170.590	172.200	173.810	175.420	100

KILOMETERS TO MILES

km	0	1	2	3	4	5	6	7	8	9	km
	miles	miles	miles	miles	miles	miles	miles	miles	miles	miles	
—		0.621	1.243	1.864	2.486	3.107	3.728	4.350	4.971	5.592	—
10	6.214	6.835	7.457	8.078	8.699	9.321	9.942	10.562	11.185	11.805	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.776	17.399	18.019	20
30	18.641	19.263	19.884	20.506	21.127	21.748	22.370	22.990	23.613	24.233	30
40	24.855	25.477	26.098	26.720	27.341	27.962	28.584	29.204	29.827	30.447	40
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.417	36.040	36.660	50
60	37.282	37.904	38.525	39.147	39.768	40.389	41.011	41.631	42.254	42.874	60
70	43.497	44.118	44.739	45.361	45.982	46.603	47.225	47.845	48.468	49.088	70
80	49.711	50.332	50.953	51.575	52.196	52.817	53.439	54.059	54.682	55.302	80
90	55.924	56.545	57.166	57.788	58.409	59.030	59.652	60.272	60.895	61.515	90
100	62.138	62.759	63.380	64.002	64.623	65.244	65.866	66.486	67.109	67.729	100

AREA

SQUARE INCHES TO SQUARE CENTIMETERS

in^2	0	1	2	3	4	5	6	7	8	9	in^2
	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	
—		6.452	12.903	19.355	25.806	32.258	38.710	45.161	51.613	58.064	—
10	64.516	70.968	77.419	83.871	90.322	96.774	103.226	109.677	116.129	122.580	10
20	129.032	135.484	141.935	148.387	154.838	161.290	167.742	174.193	180.645	187.096	20
30	193.548	200.000	206.451	212.903	219.354	225.806	232.258	238.709	245.161	251.612	30
40	258.064	264.516	270.967	277.419	283.870	290.322	296.774	303.225	309.677	316.128	40
50	322.580	329.032	335.483	341.935	348.386	354.838	361.290	367.741	374.193	380.644	50
60	387.096	393.548	399.999	406.451	412.902	419.354	425.806	432.257	438.709	445.160	60
70	451.612	458.064	464.515	470.967	477.418	483.870	490.322	496.773	503.225	509.676	70
80	516.128	522.580	529.031	535.483	541.934	548.386	554.838	561.289	567.741	574.192	80
90	580.644	587.096	593.547	599.999	606.450	612.902	619.354	625.805	632.257	638.708	90
100	645.160	651.612	658.063	664.515	670.966	677.418	683.870	690.321	696.773	703.224	100

SQUARE CENTIMETERS TO SQUARE INCHES

cm^2	0	1	2	3	4	5	6	7	8	9	cm^2
	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	
—		0.155	0.310	0.465	0.620	0.775	0.930	1.085	1.240	1.395	—
10	1.550	1.705	1.860	2.015	2.170	2.325	2.480	2.635	2.790	2.945	10
20	3.100	3.255	3.410	3.565	3.720	3.875	4.030	4.185	4.340	4.495	20
30	4.650	4.805	4.960	5.115	5.270	5.425	5.580	5.735	5.890	6.045	30
40	6.200	6.355	6.510	6.665	6.820	6.975	7.130	7.285	7.440	7.595	40
50	7.750	7.905	8.060	8.215	8.370	8.525	8.680	8.835	8.990	9.145	50
60	9.300	9.455	9.610	9.765	9.920	10.075	10.230	10.385	10.540	10.695	60
70	10.850	11.005	11.160	11.315	11.470	11.625	11.780	11.935	12.090	12.245	70
80	12.400	12.555	12.710	12.865	13.020	13.175	13.330	13.485	13.640	13.795	80
90	13.950	14.105	14.260	14.415	14.570	14.725	14.880	15.035	15.190	15.345	90
100	15.500	15.655	15.810	15.965	16.120	16.275	16.430	16.385	16.740	16.895	100

VOLUME

CUBIC INCHES TO CUBIC CENTIMETERS

in^3	0	1	2	3	4	5	6	7	8	9	in^3
	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	
		16.387	32.774	49.161	65.548	81.935	98.322	114.709	131.097	147.484	—
10	163.871	180.258	196.645	213.032	229.419	245.806	262.193	278.580	294.967	311.354	10
20	327.741	344.128	360.515	376.902	393.290	209.677	426.064	442.451	458.838	475.225	20
30	491.612	507.999	524.386	540.773	557.160	573.547	589.934	606.321	622.708	639.095	30
40	655.483	671.870	688.257	704.644	721.031	737.418	753.805	770.192	786.579	802.966	40
50	819.353	835.740	852.127	868.514	884.901	901.289	917.676	934.063	950.450	966.837	50
60	983.224	999.611	1015.998	1032.385	1048.772	1065.159	1081.546	1097.933	1114.320	1130.707	60
70	1147.094	1163.482	1179.869	1196.256	1212.643	1229.030	1245.417	1261.804	1278.191	1294.578	70
80	1310.965	1327.352	1343.739	1360.126	1376.513	1392.200	1409.288	1425.675	1442.062	1458.449	80
90	1474.836	1491.223	1507.610	1523.997	1540.384	1556.771	1573.158	1589.545	1605.932	1622.319	90
100	1638.706	1655.093	1671.481	1687.868	1704.255	1720.642	1737.029	1753.416	1769.803	1786.190	100

CUBIC CENTIMETERS TO CUBIC INCHES

cm^3(cc)	0	1	2	3	4	5	6	7	8	9	cm^3(cc)
	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	
—		0.0610	0.1220	0.1831	0.2441	0.3051	0.3661	0.4272	0.4882	0.5492	—
10	0.6102	0.6713	0.7323	0.7933	0.8543	0.9154	0.9764	1.0374	1.0984	1.1595	10
20	1.2205	1.2815	1.3425	1.4035	1.4646	1.5256	1.5866	1.6476	1.7087	1.7697	20
30	1.8307	1.8917	1.9528	2.0138	2.0748	2.1358	2.1969	2.2579	2.3189	2.3799	30
40	2.4409	2.5020	2.5630	2.6240	2.6850	2.7461	2.8071	2.8681	2.9291	2.9902	40
50	3.0512	3.1122	3.1732	3.2343	3.2953	3.3563	3.4173	3.4784	3.5394	3.6004	50
60	3.6614	3.7224	3.7835	3.8445	3.9055	3.9665	4.0276	4.0886	4.1495	4.2106	60
70	4.2717	4.3327	4.3937	4.4547	4.5158	4.5768	4.6378	4.6988	4.7599	4.8209	70
80	4.8819	4.9429	5.0039	5.0650	5.1260	5.1870	5.2480	5.3091	5.3701	5.4311	80
90	5.4921	5.5532	5.6142	5.6752	5.7362	5.7973	5.8583	5.9193	5.9803	6.0414	90
100	6.1024	6.1634	6.2244	6.2854	6.3465	6.4075	6.4685	6.5295	6.5906	6.6516	100

GALLONS (U. S.) TO LITERS

U.S. gal.	0	1	2	3	4	5	6	7	8	9	U.S. gal.
	liters	liters	liters	liters	liters	liters	liters	liters	liters	liters	
—		3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0638	—
10	37.8543	41.6397	45.4251	49.2105	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5528	117.3482	121.1337	124.9191	128.7045	132.4899	136.2754	140.0608	143.8462	147.6316	30
40	151.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2713	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0527	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6924	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4738	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1135	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

LITERS TO GALLONS (U.S.)

liters	0	1	2	3	4	5	6	7	8	9	liters
	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	
—		0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	—
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2267	4.4909	4.7551	5.0192	10
20	5.2834	5.5476	5.8118	6.0759	6.3401	6.6043	6.8684	7.1326	7.3968	7.6610	20
30	7.9251	8.1893	8.4535	8.7176	8.9818	9.2460	9.5102	9.7743	10.0385	10.3027	30
40	10.5668	10.8310	11.0952	11.3594	11.6235	11.8877	12.1519	12.4160	12.6802	12.9444	40
50	13.2086	13.4727	13.7369	14.0011	14.2652	14.5294	14.7936	15.0577	15.3219	15.5861	50
60	15.8503	16.1144	16.3786	16.6428	16.9069	17.1711	17.4353	17.6995	17.9636	18.2278	60
70	18.4920	18.7561	19.0203	19.2845	19.5487	19.8128	20.0770	20.3412	20.6053	20.8695	70
80	21.1337	21.3979	21.6620	21.9262	22.1904	22.4545	22.7187	22.9829	23.2470	23.5112	80
90	23.7754	24.0396	24.3037	24.5679	24.8321	25.0962	25.3604	25.6246	25.8888	26.1529	90
100	26.4171	26.6813	26.9454	27.2096	27.4738	27.7380	28.0021	28.2663	28.5305	28.7946	100

GALLONS (IMP.) TO LITERS

Imp gal.	0	1	2	3	4	5	6	7	8	9	Imp gal.
	liters	liters	liters	liters	liters	liters	liters	liters	liters	liters	
—		4.5460	9.0919	13.6379	18.1838	22.7298	27.2758	31.8217	36.3677	40.9136	—
10	45.4596	50.0056	54.5515	59.0975	63.6434	68.1894	72.2354	77.2813	81.8275	86.3732	10
20	90.9192	95.4652	100.0111	104.5571	109.1030	113.6490	118.1950	122.7409	127.2869	131.8328	20
30	136.3788	140.9248	145.4707	150.0167	154.5626	159.1086	163.6546	168.0005	172.7465	177.2924	30
40	181.8384	186.3844	190.9303	195.4763	200.0222	204.5682	209.1142	213.6601	218.2061	222.7520	40
50	227.2980	231.8440	236.3899	240.9359	245.4818	250.0278	254.5738	259.1197	263.6657	268.2116	50
60	272.7576	277.3036	281.8495	286.3955	290.9414	295.4874	300.0334	304.5793	309.1253	313.6712	60
70	318.2172	322.7632	327.3091	331.8551	336.4010	340.9470	345.4930	350.0389	354.5849	359.1308	70
80	363.6768	368.2223	372.7687	377.3147	381.8606	386.4066	390.9526	395.4985	400.0445	404.5904	80
90	409.1364	413.6824	418.2283	422.7743	427.3202	431.8662	436.4122	440.9581	445.9041	450.0500	90
100	454.5960	459.1420	463.6879	468.2339	472.7798	477.3258	481.8718	486.4177	490.9637	495.5096	100

LITERS TO GALLONS (IMP.)

liters	0	1	2	3	4	5	6	7	8	9	liters
	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	
—		0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5398	1.7598	1.9798	—
10	2.1998	2.4197	2.6397	2.8597	3.0797	3.2996	3.5196	3.7396	3.9596	4.1795	10
20	4.3995	4.6195	4.8395	5.0594	5.2794	5.4994	5.7194	5.9394	6.1593	6.3793	20
30	6.5993	6.8193	7.0392	7.2592	7.4792	7.6992	7.9191	8.1391	8.3591	8.5791	30
40	8.7990	9.0190	9.2390	9.4590	9.6789	9.8989	10.9189	10.3389	10.5588	10.7788	40
50	10.9988	11.2188	11.4388	11.6587	11.8787	12.0987	12.3187	12.5386	12.7586	12.9786	50
60	13.1986	13.4185	13.6385	13.8585	14.0785	14.2984	14.5184	14.7384	14.9584	15.1783	60
70	15.3983	15.6183	15.8383	16.0582	16.2782	16.4982	16.7182	16.9382	17.1581	17.3781	70
80	17.5981	17.8181	18.0380	18.2580	18.4780	18.6980	18.9179	19.1379	19.3579	19.5779	80
90	19.7978	20.0178	20.2378	20.4578	20.6777	20.8977	21.1177	21.3377	21.5576	21.7776	90
100	21.9976	22.2176	22.4376	22.6575	22.8775	23.0975	23.3175	23.5374	23.7574	23.9774	100

MASS

POUNDS TO KILOGRAMS

lbs.	0	1	2	3	4	5	6	7	8	9	lbs.
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
—		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	—
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.730	42.184	42.638	43.092	43.545	43.998	44.453	44.906	90
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442	100

KILOGRAMS TO POUNDS

kg	0	1	2	3	4	5	6	7	8	9	kg
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
—		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	—
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.752	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.389	92.594	94.799	97.003	99.208	101.410	103.620	105.820	108.030	40
50	110.230	112.440	114.640	116.840	119.050	121.250	123.460	125.660	127.870	130.070	50
60	132.280	134.480	136.690	138.890	141.100	143.300	145.510	147.710	149.910	152.120	60
70	154.320	156.530	158.730	160.940	163.140	165.350	167.550	169.760	171.960	174.170	70
80	176.370	178.570	180.780	182.980	185.190	187.390	189.600	191.800	194.010	196.210	80
90	198.420	200.620	202.830	205.030	207.230	209.440	211.640	213.850	216.050	218.260	90
100	220.460	222.670	224.870	227.080	229.280	231.490	233.690	235.890	238.100	240.300	100

KILOGRAMS TO NEWTON

kg	0	1	2	3	4	5	6	7	8	9	kg
	N	N	N	N	N	N	N	N	N	N	
—	—	9.81	19.61	29.42	39.23	49.03	58.81	68.65	78.45	88.26	—
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.33	500.14	509.95	519.75	529.56	539.37	549.17	558.98	568.79	578.59	50
60	558.40	598.21	608.01	617.82	627.63	637.43	647.24	657.05	666.85	676.66	60
70	686.47	696.27	706.08	715.89	725.69	735.50	745.31	755.11	764.92	774.73	70
80	784.53	794.34	804.15	813.95	823.76	833.57	843.37	853.18	862.99	872.79	80
90	882.60	892.41	902.21	912.02	921.83	931.63	941.44	951.25	961.05	970.86	90
100	980.66	990.47	1000.30	1010.08	1019.89	1029.69	1039.47	1049.31	1059.11	1068.92	100

NEWTON TO KILOGRAMS

N	0	10	20	30	40	50	60	70	80	90	N
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
—	—	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	—
100	10.197	11.217	12.237	13.256	14.276	15.296	16.315	17.335	18.355	19.375	100
200	20.394	21.414	22.434	23.453	24.473	25.493	26.513	27.532	28.552	29.572	200
300	30.591	31.611	32.631	33.651	34.670	35.690	36.710	37.729	38.749	39.769	300
400	40.789	41.808	42.828	43.848	44.868	45.887	46.907	47.927	48.946	49.966	400
500	50.986	52.006	53.025	54.045	55.065	56.084	57.104	58.124	59.144	60.163	500
600	61.183	62.203	63.222	64.242	65.262	66.282	67.301	68.321	69.341	70.360	600
700	71.380	72.400	73.420	74.439	75.459	76.479	77.498	78.518	79.538	80.558	700
800	81.577	82.597	83.617	84.636	85.656	86.676	87.696	88.715	89.735	90.755	800
900	91.774	92.794	93.814	94.834	95.853	96.873	97.893	98.912	99.932	100.951	900
1000	101.972	102.990	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	1000

PRESSURE

POUNDS PER SQUARE INCHES TO KILOGRAMS PER SQUARE CENTIMETERS

lb/in² (psi)	0 kg/cm²	1 kg/cm²	2 kg/cm²	3 kg/cm²	4 kg/cm²	5 kg/cm²	6 kg/cm²	7 kg/cm²	8 kg/cm²	9 kg/cm²	lb/in² (psi)
—		0.0703	0.1406	0.2100	0.2812	0.3515	0.4218	0.4921	0.5625	0.6328	—
10	0.7031	0.7734	0.8437	0.9140	0.9843	1.0546	1.1249	1.1952	1.2655	1.3358	10
20	1.4062	1.4765	1.5468	1.6171	1.6874	1.7577	1.8280	1.8983	1.9686	2.0389	20
30	2.1092	2.1795	2.2498	2.3202	2.3905	2.4608	2.5311	2.6014	2.6717	2.7420	30
40	2.8123	2.8826	2.9529	3.0232	3.0935	3.1639	3.2342	3.3045	3.3748	3.4451	40
50	3.5154	3.5857	3.6560	3.7263	3.7966	3.8669	3.9372	4.0072	4.0779	4.1482	50
60	4.2185	4.2888	4.3591	4.4294	4.4997	4.5700	4.6403	4.7106	4.7809	4.8512	60
70	4.9216	4.9919	5.0622	5.1325	5.2028	5.2731	5.3434	5.4137	5.4840	5.5543	70
80	5.6246	5.6949	5.7652	5.8356	5.9059	5.9762	6.0465	6.1168	6.1871	6.2574	80
90	6.3277	6.3980	6.4683	6.5386	6.6089	6.6793	6.7496	6.8199	6.8902	6.9605	90
100	7.0308	7.1011	7.1714	7.2417	7.3120	7.3823	7.4526	7.5229	7.5933	7.6636	100

KILOGRAMS PER SQUARE CENTIMETERS TO POUNDS PER SQUARE INCHES

kg/cm²	0 lb/in²(psi)	1 lb/in²(psi)	2 lb/in²(psi)	3 lb/in²(psi)	4 lb/in²(psi)	5 lb/in²(psi)	6 lb/in²(psi)	7 lb/in²(psi)	8 lb/in²(psi)	9 lb/in²(psi)	kg/cm²
—		14.22	28.45	42.67	56.89	71.12	85.34	99.56	113.78	128.01	—
10	142.23	156.45	170.68	184.90	199.12	213.35	227.57	241.79	256.02	270.24	10
20	284.46	298.69	312.91	327.13	341.36	355.58	369.80	384.03	398.25	412.47	20
30	426.70	440.92	455.14	469.36	483.59	497.81	512.03	526.26	540.48	554.70	30
40	568.93	583.15	597.37	611.60	625.82	640.04	654.27	668.49	682.71	696.94	40
50	711.16	725.38	739.61	753.83	768.05	782.28	796.50	810.72	824.94	839.17	50
60	853.39	867.61	881.84	896.06	910.28	924.51	938.73	952.95	967.18	981.40	60
70	995.62	1009.80	1024.10	1038.30	1052.50	1066.70	1081.00	1095.20	1109.40	1123.60	70
80	1137.80	1152.10	1166.30	1180.50	1194.70	1209.00	1223.20	1237.40	1251.60	1265.90	80
90	1280.10	1294.30	1308.50	1322.70	1337.00	1351.20	1365.40	1379.60	1393.90	1408.10	90
100	1422.30	1436.50	1450.80	1465.00	1479.20	1493.40	1507.70	1521.90	1536.10	1550.30	100

KILOGRAMS PER SQUARE CENTIMETERS TO KILO PASCAL

kg/cm²	0 KPa	1 KPa	2 KPa	3 KPa	4 KPa	5 KPa	6 KPa	7 KPa	8 KPa	9 KPa	kg/cm²
—	—	98.1	196.1	294.2	392.3	490.3	588.4	686.5	784.5	882.6	—
10	980.7	1078.7	1176.8	1274.9	1372.9	1471.0	1569.1	1667.1	1765.2	1863.3	10
20	1961.3	2059.4	2157.5	2255.5	2353.6	2451.7	2549.7	2647.8	2745.9	2843.9	20
30	2942.0	3040.1	3138.1	3236.2	3334.3	3432.3	3530.4	3628.5	3726.5	3824.6	30
40	3922.7	4020.7	4118.8	4216.9	4314.9	4413.0	4511.1	4609.1	4707.2	4805.3	40
50	4903.3	5001.4	5099.5	5197.5	5295.6	5393.7	5491.7	5589.8	5687.9	5785.9	50
60	5584.0	5982.1	6080.1	6178.2	6276.3	6374.3	6472.4	6570.5	6668.5	6766.6	60
70	6864.7	6962.7	7060.8	7158.9	7256.9	7355.0	7453.1	7551.1	7649.2	7747.3	70
80	7845.3	7943.4	8041.5	8139.5	8237.6	8335.7	8433.7	8531.8	8629.9	8727.9	80
90	8826.0	8924.1	9022.1	9120.2	9218.3	9316.3	9414.4	9512.5	9610.5	9708.6	90
100	9806.6	9904.7	10003.7	10101.8	10198.9	10296.9	10395.0	10493.1	10591.1	10689.2	100

KILO PASCAL TO KILOGRAMS PER SQUARE CENTIMETERS

KPa	0 kg/cm²	100 kg/cm²	200 kg/cm²	300 kg/cm²	400 kg/cm²	500 kg/cm²	600 kg/cm²	700 kg/cm²	800 kg/cm²	900 kg/cm²	KPa
—	—	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	—
1000	10.197	11.217	12.237	13.256	14.276	15.296	16.315	17.335	18.355	19.375	1000
2000	20.394	21.414	22.434	23.453	24.473	25.493	26.513	27.532	28.552	29.572	2000
3000	30.591	31.611	32.631	33.651	34.670	35.690	36.710	37.729	38.749	39.769	3000
4000	40.789	41.808	42.828	43.848	44.868	45.887	46.907	47.927	48.946	49.966	4000
5000	50.986	52.006	53.025	54.045	55.065	56.084	57.104	58.124	59.144	60.163	5000
6000	61.183	62.203	63.222	64.242	65.262	66.282	67.301	68.321	69.341	70.360	6000
7000	71.380	72.400	73.420	74.439	75.459	76.479	77.498	78.518	79.538	80.558	7000
8000	81.577	82.597	83.617	84.636	85.656	86.676	87.696	88.715	89.735	90.755	8000
9000	91.774	92.794	93.814	94.834	95.853	96.873	97.893	98.912	99.932	100.951	9000
10000	101.972	102.990	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	10000

TORQUE

FOOT POUNDS TO KILOGRAMMETERS

ft. lbs.	0 kg-m	1 kg-m	2 kg-m	3 kg-m	4 kg-m	5 kg-m	6 kg-m	7 kg-m	8 kg-m	9 kg-m	ft. lbs.
—		0.138	0.276	0.415	0.553	0.691	0.829	0.967	1.106	1.244	—
10	1.382	1.520	1.658	1.796	1.934	2.073	2.211	2.349	2.487	2.625	10
20	2.764	2.902	3.040	3.178	3.316	3.455	3.593	3.731	3.869	4.007	20
30	4.146	4.284	4.422	4.560	4.698	4.837	4.975	5.113	5.251	5.389	30
40	5.528	5.666	5.804	5.942	6.080	6.219	6.357	6.495	6.633	6.771	40
50	6.910	7.048	7.186	7.324	7.462	7.601	7.739	7.877	8.015	8.153	50
60	8.292	8.430	8.568	8.706	8.844	8.983	9.121	9.259	9.397	9.535	60
70	9.674	9.812	9.950	10.088	10.227	10.365	10.503	10.641	10.779	10.918	70
80	11.056	11.194	11.332	11.470	11.609	11.747	11.885	12.023	12.161	12.300	80
90	12.438	12.576	12.714	12.855	12.991	13.129	13.267	13.405	13.544	13.682	90
100	13.820	13.958	14.096	14.235	14.373	14.511	14.649	14.787	14.925	14.064	100

KILOGRAMMETERS TO FOOT POUNDS

kg-m	0 ft. lbs.	1 ft. lbs.	2 ft. lbs.	3 ft. lbs.	4 ft. lbs.	5 ft. lbs.	6 ft. lbs.	7 ft. lbs.	8 ft. lbs.	9 ft. lbs	kg-m
—		7.23	14.47	21.70	28.93	36.17	43.40	50.63	57.87	65.10	—
10	72.33	79.57	86.80	94.03	101.27	108.50	115.74	122.97	130.20	137.43	10
20	144.67	151.90	159.13	166.37	173.60	180.84	188.08	195.30	202.54	209.77	20
30	217.00	224.23	231.46	238.70	245.93	253.17	260.41	267.63	274.87	282.10	30
40	289.34	296.57	303.79	311.04	318.27	325.50	332.75	339.98	347.21	354.44	40
50	361.66	368.89	376.12	383.36	390.59	397.82	405.07	412.30	419.53	426.76	50
60	434.00	441.23	448.45	455.70	462.93	470.17	477.41	484.64	491.87	499.10	60
70	506.34	513.57	520.80	528.04	535.27	542.50	549.75	556.98	564.21	571.44	70
80	578.68	585.91	593.14	600.38	607.61	614.85	622.09	629.41	636.55	643.78	80
90	651.00	658.23	665.46	672.70	679.93	687.17	694.41	701.63	708.87	716.10	90
100	723.34	730.57	737.80	745.04	752.27	759.51	766.75	774.07	781.21	788.44	100

TEMPERATURE

FAHRENHEIT TO CENTIGRADE

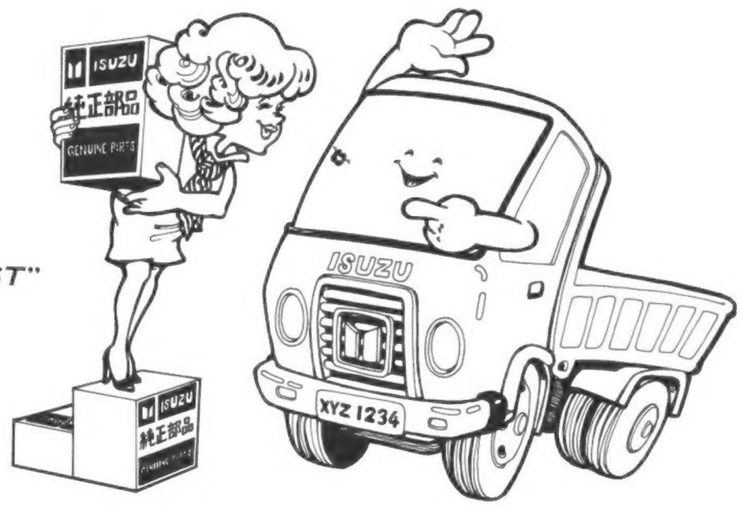
°F	°C	°F	°C
-20	-28.9	90	32.2
-15	-26.1	95	35.0
-10	-23.3	100	37.8
-5	-20.6	105	40.6
0	-17.8	110	43.3
1	-17.2	115	46.1
2	-16.7	120	48.9
3	-16.1	125	51.7
4	-15.6	130	54.4
5	-15.0	135	57.2
10	-12.2	140	60.0
15	-9.4	145	62.8
20	-6.7	150	65.6
25	-3.9	155	68.3
30	-1.1	160	71.1
35	1.7	165	73.9
40	4.4	170	76.7
45	7.2	175	79.4
50	10.0	180	82.2
55	12.8	185	85.0
60	15.6	190	87.8
65	18.3	195	90.6
70	21.1	200	93.3
75	23.9	205	96.1
80	26.7	210	98.9
85	29.4	212	100.0

CENTIGRADE TO FAHRENHEIT

°C	°F	°C	°F
-30	-22.0	28	82.4
-28	-18.4	30	86.0
-26	-14.8	32	89.6
-24	-11.2	34	93.2
-22	-7.6	36	96.8
-20	-4.0	38	100.4
-18	-0.4	40	104.0
-16	3.2	42	107.6
-14	6.8	44	112.2
-12	10.4	46	114.8
-10	14.0	48	118.4
-8	17.6	50	122.0
-6	21.2	52	125.6
-4	24.8	54	129.2
-2	28.4	56	132.8
0	32.0	58	136.4
2	35.6	60	140.0
4	39.2	62	143.6
6	42.8	64	147.2
8	46.4	66	150.8
10	50.0	68	154.4
12	53.6	70	158.0
14	57.2	75	167.0
16	60.8	80	176.0
18	64.4	85	185.0
20	68.0	90	194.0
22	71.6	95	203.0
24	75.2	100	212.0
26	78.8		

MEMO

"QUALITY PARTS
YOU CAN TRUST"



1924-WE-101

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Issued by

ISUZU MOTORS LIMITED

OVERSEAS SERVICE DEPARTMENT

Tokyo, Japan

First edition Dec., 1980 12-16K-4